Lake Michigan Committee
2004 Annual Meeting
Ypsilanti, Michigan
March 24-25, 2004
(second edition)

Lake Michigan Management Reports

Lake Michigan Fisheries Team
Wisconsin Department of Natural Resources

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INTRODUCTION

These reports summarize some of the major studies and stock assessment activities by the Wisconsin Department of Natural Resources on Lake Michigan during 2003. They provide specific information about the major sport and commercial fisheries, and describe trends in some of the major fish populations. The management of Lake Michigan fisheries is conducted in partnership with other state, federal, and tribal agencies, and in consultation with sport and commercial fishers. Major issues of shared concern are resolved through the Lake Michigan Committee, which is made up of representatives of Michigan, Indiana, Illinois, Wisconsin, and the Chippewa Ottawa Resource Authority. These reports are presented to the Lake Michigan Committee as part of Wisconsin's contribution to that shared management effort.

For further information regarding any individual report, contact the author at the address, phone number, or e-mail address shown at the end of the report, or contact the Department's Great Lakes Fisheries Specialist, Bill Horns, at 608-266-87782 or william.horns@dnr.state.wi.us.

SPORTFISHING EFFORT AND HARVEST

Open-water fishing effort was 2,701,811 hours during 2003, 1.1% below the five-year average of 2,732,916 (Table 1). The shore, pier and stream fisheries accounted for the majority of the fishing effort decreases estimated in 2003. The charter and moored-boat fishery effort decreased slightly in 2003, as did the ramp fishery. Overall fishing effort dropped in 2003 compared to 2002.

Wisconsin anglers had an excellent salmonid fishery during 2003. Trout and salmon harvest was 464,453, 27% above the five-year average (Tables 2-4). Chinook salmon harvest showed the largest increase, 77% above the 5-year mean and the highest estimated harvest recorded since 1987. Because of the extremely successful chinook fishery and low stream water levels in 2003, the harvest of other salmon and trout species declined from the 5-year mean (i.e. –28% to –53%).

The estimated open-water harvest of yellow perch was 156,321 fish, a decrease from the last few years (Table 2). In recent years, the yellow perch harvest has been supported almost entirely by the 1998 year-lass. As the aging 1998s decline in abundance, yellow perch harvest will likely continue to decline in the near future. Walleye harvest was estimated at 22,806, while smallmouth bass and northern pike harvests were 19,253 and 3,344, respectively. For more detailed summaries, check out the Lake Michigan website at http://www.dnr.state.wi.us/org/water/fhp/fish/lakemich/.

Table 1. Fishing effort (angler hours) by various angler groups in Wisconsin waters of Lake Michigan and Green Bay during 2003 and percent change from the 5-year average (1999 – 2002).

YEAR	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
2002	1,429,605	348,323	238,789	150,784	227,609	306,701	2,701,811
% change	+ 5%	- 13%	+ 1%	- 4%	+ 5%	-14%	- 1%

Table 2. Sport harvest by fishery type and species for Wisconsin waters of Lake Michigan and Green Bay during 2003.

SPECIES	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	**TOTAL**
Coho salmon	19,256	15,889	13,171	327	1,499	473	**50,625**
Chinook salmon	139,083	73,595	70,007	3,431	5,432	26,071	**317,619**
Rainbow trout	20,727	12,465	8,625	749	1,406	4,576	**48,548**
Brown trout	7,664	1,741	1,423	3,824	6,574	2,428	**23,654**
Brook trout	47	0	30	12	37	0	**126**
Lake trout	9,458	7,448	6,781	121	47	26	**23,881**
Northern pike	3,115	-	-	43	186	0	**3,344**
Smallmouth bass	10,870	6,427	-	624	1,288	44	**19,253**
Yellow perch	123,999	13,784	-	7,948	10,270	320	**156,321**
Walleye	18,818	2,573	-	65	32	1,318	**22,806**
TOTAL	**353,037**	**133,922**	**100,037**	**17,144**	**26,771**	**35,256**	**666,177**

Table 3. Trout and salmon harvest by species in Wisconsin waters of Lake Michigan, 1986-2003.

Species	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	TOTAL
Brook Trout	4,587	1,369	5,148	2,192	5,927	1,659	4,431	1,967	7,481	1,914	419	299	159	574	199	263	144	126	38,858
Brown Trout	68,806	82,397	59,397	55,036	45,092	59,164	51,554	64,546	52,397	49,654	38,093	43,224	27,371	37,187	40,966	26,421	35,220	23,654	860,179
Rainbow Trout	26,483	56,055	60,860	87,987	51,711	67,877	79,525	104,769	114,776	117,508	77,099	94,470	110,888	84,248	71,829	72,854	74,031	48,548	1,401,518
Chinook Salmon	356,900	396,478	176,294	189,251	111,345	139,080	103,564	87,365	99,755	162,888	183,254	130,152	136,653	157,934	136,379	191,378	275,454	317,619	3,351,743
Coho Salmon	127,919	111,886	136,695	105,224	64,083	44,195	70,876	74,304	110,001	65,647	104,715	138,423	59,203	56,297	87,927	47,474	102,313	50,625	1,557,807
Lake Trout	96,858	113,930	89,227	94,614	75,177	85,841	52,853	61,123	53,989	69,332	36,849	57,954	82,247	39,819	31,151	40,408	39,865	23,881	1,145,118
TOTAL	**681,553**	**762,115**	**527,621**	**534,304**	**353,335**	**397,816**	**362,803**	**394,074**	**438,399**	**466,943**	**440,429**	**464,522**	**416,521**	**376,059**	**368,451**	**378,798**	**527,027**	**464,453**	**8,355,223**
Harvest Per Hour	0.1469	0.1593	0.1068	0.1220	0.0979	0.1103	0.0980	0.1213	0.1256	0.1426	0.1481	0.1619	0.1451	0.1331	0.1614	0.1382	0.1789	0.1719	0.1350

Table 4. Trout and salmon harvest by angler group in Wisconsin waters of Lake Michigan, 1986-2003.

Fisheries Type	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	TOTAL
Ramp	255,559	266,036	222,428	173,224	118,439	150,840	111,260	145,689	167,388	193,752	176,085	190,976	155,953	141,903	170,081	156,470	236,241	196,235	3,228,559
Moored	186,611	225,586	98,908	184,011	97,206	103,633	111,441	110,507	134,315	128,743	125,017	129,332	141,538	100,078	68,872	85,435	110,094	111,148	2,252,475
Charter	124,282	150,249	133,861	125,969	85,773	88,490	71,113	81,490	81,909	84,898	86,346	94,556	84,867	73,622	91,665	76,868	106,631	100,037	1,742,626
Pier	47,643	44,280	26,527	7,548	6,946	8,701	10,867	9,144	15,130	14,621	6,218	5,002	4,200	4,614	4,402	7,327	10,629	8,464	242,263
Shore	27,947	30,043	22,945	13,268	14,538	16,830	16,602	13,645	16,370	17,676	19,676	16,726	8,997	12,685	13,971	18,308	20,111	14,995	315,333
Stream	39,511	45,921	22,952	30,284	30,433	29,322	41,520	33,599	23,287	27,253	27,087	27,930	20,966	43,157	19,460	34,390	43,321	33,574	573,967
TOTAL	**681,553**	**762,115**	**527,621**	**534,304**	**353,335**	**397,816**	**362,803**	**394,074**	**438,399**	**466,943**	**440,429**	**464,522**	**416,521**	**376,059**	**368,451**	**378,798**	**527,027**	**464,453**	**8,355,223**

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WISCONSIN'S 2003 WEIR HARVEST

The Wisconsin Department of Natural Resources (WDNR) operates three salmonid egg collection stations on Lake Michigan tributaries. The Strawberry Creek Weir (SCW) which has been in operation since the early 1970's, is located on Strawberry Creek in Door County near Sturgeon Bay and is the primary facility for chinook salmon *Oncorhynchus tshawytscha*. The Buzz Besadny Anadromous Fisheries Facility (BAFF) has been in operation since 1990 and is located on the Kewaunee River in Kewaunee County near Kewaunee. BAFF is a co-primary egg collection station for three strains of steelhead *O. mykiss*, and coho salmon *O. kisutch.* BAFF also serves as a backup for Chinook salmon egg collection. The Root River Steelhead facility (RRSF) has been in operation since 1994 and is located on the Root River in Racine County in Racine. RRSF is a co-primary egg collection station for the three strains of steelhead, and coho and serves as a backup for Chinook salmon egg collection.

Strawberry Creek is a rather small creek with no public land above the SCW. As a result all fish returning to SCW are harvested. Surplus eggs are sold under contract to a bait dealer and salmon carcasses are removed. The Kewaunee River is a rather large tributary to Lake Michigan and there is a considerable amount of public frontage below and above the BAFF. As a result salmonids captured at BAFF but not needed for hatchery egg production are released for the sport stream fishery. A large sport stream fishery has developed on the Root River, and salmonids captured at the RRSF but not needed for hatchery egg production are also released.

Salmonid egg harvest quotas vary from one year to the next based on projections to satisfy WDNR hatchery needs and accommodate egg requests from other agencies. In 2003 the projected salmonid egg quotas were: 3.8 million chinook salmon eggs, 2.0 million coho salmon eggs, 1.5 million steelhead eggs.

Low Stream flow and low Lake Michigan water level was a potential problem for chinook harvest at SCW again in the fall of 2003. However, the 3,500 foot pipeline and pump capable of pumping approximately 1,500 gallons of water per minute, that was installed in the early fall of 2000 was utilized again during fall 2003. This pump and pipeline delivered water to Strawberry Creek above the SCW and created an artificial flow sufficient for attracting and harvesting chinook. As a result SCW was able to operate despite the low water conditions and the majority of the Chinook salmon egg quota was collected at SCW in 2003. During the fall of 2003, it is doubtful that either BAFF or RRSF would have been able to collect the chinook egg quota. Coho egg collection was also limited by the low flow and low water conditions. Surplus eggs from other state agencies were required to fill coho egg quotas in 2003.

Table 1. Yearly summary of chinook salmon returns and egg collection at Strawberry Creek, 1981 through 2003.

Harvest Year	Total fish Live and Dead	Adipose clipped fish	Total Weight (pounds)	Hatchery Egg Production[1]	
				Number	Pounds
1981	4,314	-	74,209	9,786,000	9,786
1982	3,963	-	60,206	7,728,000	7,728
1983	3,852	48	66,091	6,954,000	6,954
1984	5,208	64	76,905	7,652,000	7,652
1985	5,601	582	90,860	7,085,000	7,058
1986	4,392	322	53,700	5,052,000	5,052
1987	7,624	701	99,100	4,929,000	4,929
1988	3,477	408	43,645	3,997,000	3,997
1989	1,845	301	20,849[2]	1,350,000	1,350
1990	3,016	501	47,091[2]	2,378,000	2,378
1991	3,009	377	43,630[2]	1,649,000	1,649
1992	4,099	382	51,878[2]	1,677,100	1,677
1993	4,377	582	66,094[2]	2,156,666	2,156
1994	4,051	733	63,195[2]	3,426,026	3,426
1995	2,381	408	30,001[2]	2,221,446	2,221
1996	6,653	1,185	97,134[2]	4,720,000	4,720
1997	4,850	969	78,085[2]	4,060,944	4,606
1998	5,035	1,092	61,427[2]	3,489,144	3,489
1999[3]	1,934	535	21,081[2]	633,000	633
2000[4]	6,649	2,201	75,400[2]	3,672,771	3,673
2001[4]	8,125	2,566	119,438[2]	3,775,982	3,776
2002[4]	11,027	3,678	160,994[2]	3,820,396	3,820
2003[4]	6,086	1,614		3,421,976	3,422

1 Chinook salmon eggs harvested for hatchery production (does not include eggs sold for bait).
2 Annual average weight per fish used to estimate total weight (2002 average weight was 14.6 pounds).
3 During 1999 extreme low flow conditions persisted throughout the summer and fall in Strawberry Creek, and these conditions are known to have limited the ability of chinook to return to the weir. All values for 1999 were affected by these low flow conditions.
4 During 2000, 2001, 2002, and 2003 extreme low stream flow and low lake levels persisted. A pipeline was installed which delivered approximately 1500 gallons of water per minute, and allowed weir operation.

The Chinook salmon return to BAFF during the fall of 2003 was only about 20 percent of the previous years return (Table 2). Lower numbers of chinook imprinted to return to BAFF during the fall of 2003 and low water level and low flow conditions no doubt played a major role in the number of chinook returning to BAFF. Although 184,000 chinook eggs were collected at BAFF in 2003, it is unlikely that BAFF would have provided adequate backup had problems occurred at SCW.

Table 2. Yearly summary of chinook returns and egg collection at the Besadny Anadromous Fisheries Facility, 1990 through 2003.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total number of fish examined	Adipose clipped	Number of eggs harvested
CHINOOK SALMON							
1990	1,307	1,797			3,104	214	1,081,000
1991	2,390	966			3,356	21	1,880,000
1992	2,254	995	625		3,874	120	2,148,000
1993	2,180	726	354		3,260	241	880,000
1994	813	847	62		1,722	452	471,000
1995	1,182	1,362	77		2,621	737	1,360,000
1996	952	2,029	212		3,193	629	700,000
1997	144	1,139	235		1,518	148	0
1998	695	2,858	452		4,005	72	1,155,080
1999	1,803	3,189	806		5,798	496	3,291,346
2000	720	1,733	321		2,774	741	0
2001	4,322	1,066	48		5,092	2,063	0
2002	4,929	174	1,121		6,224	2,713	0
2003	1,075	*	122		1,197	22	184,224

*During weir operation in 2003,bypass gates were intentionally left open at times to allow fish to move upstream without being trapped. It is unknown how many chinook were able to move upstream through the bypass.

The coho salmon return to BAFF in the fall of 2003 was 266 (Table 3). This is well below the fourteen-year average of 1,646. Approximately 0.156 million coho salmon eggs were collected at BAFF in the fall of 2003. Low flow in the Kewaunee River no doubt affected the coho return, but is not likely the only factor responsible for the low returns of coho at BAFF in 2003.

Table 3. Yearly summary of coho salmon returns and egg collection at the Besadny Anadromous Fisheries Facility, 1990 through 2003.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total number of fish examined	Adipose clipped	Number of eggs harvested
COHO SALMON							
1990	1,889	1,813		185	3,887		1,374,000
1991	780	287		73	1,140		790,000
1992	307	596			958		163,000
1993	448	130	326	725	1,671		529,000
1994	433	185	97		746		350,000
1995	698	2,744	325		3,767		535,000
1996	632	989	248		3,328[1]	54	688,000
1997	773	337	52		1,162	251	524,000
1998	847	1,518	67		2,432	299	607,898
1999	809	536	143	150	1,638		1,445,423
2000	768	656	205		1,629		1,115,000
2001	124	34	17		175		109,000
2002	184	37	20		241		160,000
2003	255	11			266		156,222

1 Coho salmon total includes 1,459 fish sacrificed for disease control

The steelhead return to BAFF in 2003 was 371 (Table 4), with all returns observed during the spring run. This was the second lowest spring steelhead return and the lowest fall return since BAFF was established for steelhead egg collection. Low flow and low lake level could be partially responsible for the low return, but other factors are likely contributing to the reduced return. Since 1992, the yearly average run at BAFF has been 1,675 steelhead.

Table 4. Yearly summary of steelhead returns and egg collection at the Besadny Anadromous Fisheries Facility, 1990 through 2003.

Year	Number of fish harvested	Fish passed upstream	Dead fish	Hatchery transfer	Total fish examined	Adipose clipped	Number of eggs harvested
1992 – Spring		2,892	446		3,338		
1992 – Fall		66		408	474		
1993 – Spring		2,096	177		2,273		
1993 – Fall		30		175	205		
1994 – Spring		2,804	164		2,968		
1994 – Fall		321		200	521		
1995 – Spring		1,696	151		1,847		756,000
1995 – Fall		457	9	121	587		
1996 – Spring		1,964	180		2,144		454,000
1996 – Fall		24	18	151	193		
1997 – Spring		1,955	136		2,091		780,000
1997 – Fall		85	6	40	131		50,600
1998 – Spring		746	130		876		400,000
1998 – Fall		41	2	7	50		15,000
1999 – Spring		608	124	0	732		508,000
1999 – Fall		61	7	77	145		100,000
2000 – Spring		220	120	0	340		259,000
2000 – Fall		2	0	5	7		0
2001 – Spring		324	89	0	413		269,000
2001 – Fall		6	0	7	13		Unknown
2002 – Spring		307	69	0	376		Unknown
2002 – Fall		3	0	0	3		0
2003 – Spring		307	64	0	371		80,000
2003 – Fall		0	0	0	0		0

Near-drought conditions resulted in a very poor return of fish to the RRSF in the fall of 2003. Only 149 chinook salmon and 198 coho salmon were captured. (Table 5). No chinook salmon eggs were collected for hatchery production at RRSF in the fall of 2003 as all chinook eggs were collected at SCW during the fall of 2003. Approximately 150,000 coho eggs were collected.

Table 5. Yearly summary of chinook and coho salmon returns and egg collection at the Root River Steelhead Facility, 1994 through 2003.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total number of fish	Adipose clipped	Number of eggs harvested
CHINOOK SALMON							
1994	129	1,726	3		1,858	3	
1995	300	2,663	16		2,979	1	1,020,000
1996	62	5,440	87		5,589		644,000
1997	76	3,974	52		4,102		0
1998	127	3,845	5		3,977	2	93,000
1999	338	5,381	303		6,022		800,000
2000	267	6,972	143		7,382		No data
2001	288	9,697	229		10,214		No data
2002	120	10,011	308		10,439		No data
2003	0	149	0		149		No data
COHO SALMON							
1994	285	513	15		813		
1995	199	2,115	1,040		3,321	3	330,000
1996	161	3,940	305		4,406		2,200,000
1997	65	6,909	16	655	7,645		1,750,000
1998	90	3,336	246	328	4,000	1	760,000
1999	60	978	5	107	1,150		150,000
2000	75	2,921	181	231	3,408		1,200,000
2001	71	942	23	291	1,327		800,000
2002	217	2,076	63	192	2,548	140	850,000
2003	72	126	0	0	198	7	150,000

Steelhead return at RRSF in 2003 was 1,296 (Table 6). Most of these steelhead (1,060 or 82 percent) returned in the spring and were likely either Chambers Creek or Ganaraska strain. The steelhead returning in fall (236 or 18 percent) were primarily Skamania strain. Approximately 0.5 million steelhead eggs were collected at RRSF in spring 2003 and at this time the egg take from fall steelhead has not been completed.

Table 6. Yearly summary of steelhead returns and egg collection at the Root River Steelhead Facility, 1994 through 2003.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total fish examined	Adipose clipped	Number of eggs harvested
STEELHEAD							
1994 – Fall		583	47	218	848	2	200,000
1995 – Spring	120	2,582	18		2,720	2	1,008,000
1995 – Fall		208		330	538	1	300,000
1996 – Spring	150	2,970	49		3,169		775,000
1996 – Fall		105		248	353		240,000
1997 – Spring	2	2,918	125		3,045		777,000
1997 – Fall		228	2	408	638		500,000
1998 – Spring		382			382		320,000
1998 – Fall		64	1	86	151		184,000
1999 – Spring		2,131			2,263		
1999 – Fall		19	1	50	70		
2000 – Spring	64	2,107	0	0	2,171		1,552,476
2000 – Fall	0	59	0	160	219		145,922
2001 – Spring	69	790			859		788,000
2001 – Fall		176		314	490		No data
2002 – Spring	123	1,180		0	1,303	2	1,425000
2002 – Fall		48	3	250	301		No data
2003 – Spring	83	977	0	0	1,060		560,000
2003 – Fall	0	6	0	230	236		No data

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STATUS OF THE COMMERCIAL CHUB FISHERY AND CHUB STOCKS

The total chub harvest from commercial gill nets was 1,171,840 pounds for calendar year 2003, a decrease of 12% from 2002 (Tables 1 and 2). Commercial smelt trawlers harvested 73,065 pounds of unmarketable chubs incidental to the targeted smelt harvest which represents a 50% decrease from 2002, when 147,465 pounds of unsorted fish were harvested. In addition to this take in 2003, 14,124 pounds were sorted as marketable catch.

By zone, the harvest in the south was 1,069,148 pounds, a 16% decrease compared to the 2002 harvest, while in the north, 102,692 pounds were reported caught, an increase of 61% compared to 2002. CPEs were very similar between zones with a significant decrease in the north compared to 2002. The south showed a 7% decrease while the north had a 24% decrease from 2002. Effort declined in the southern zone by about 2.3 million feet and more than doubled in the north by about 1.2 million feet. In the south, 34 of the 43 permit holders reported harvesting chubs while in the north 8 of 21 reported harvesting chubs.

Table 1. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Southern Zone gillnet chub fishery 1979-2003. The actual quota is broken down into three separate periods and runs from July 1 of the previous year to June 30 of the current.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT (x1,000 FT)	CPE
1979	992,143	900,000		12,677.2	78.3
1980	1,014,259	900,000		21,811.6	46.5
1981	1,268,888	1,100,000		18,095.6	70.1
1982	1,538,657	1,300,000		16,032.6	96.0
1983	1,730,281	1,850,000		19,490.0	88.8
1984	1,697,787	2,400,000		30,868.7	55.0
1985	1,625,018	2,550,000		32,791.1	49.6
1986	1,610,834	2,700,000		34,606.1	46.5
1987	1,411,742	3,000,000	59	32,373.9	43.6
1988	1,381,693	3,000,000	60	58,439.0	23.6
1989	1,368,945	3,000,000	64	48,218.1	27.6
1990	1,709,109	3,000,000	54	41,397.4	41.3
1991	1,946,793	3,000,000	58	45,288.3	43.0
1992	1,636,113	3,000,000	53	40,483.7	40.4
1993	1,520,923	3,000,000	58	42,669.8	35.6
1994	1,698,757	3,000,000	65	35,085.5	48.4
1995	1,810,953	3,000,000	59	28,844.9	62.8
1996	1,642,722	3,000,000	56	27,616.6	59.5
1997	2,094,397	3,000,000	53	28,441.8	73.6
1998	1,665,286	3,000,000	49	23,921.1	69.6
1999	1,192,590	3,000,000	46	25,253.2	47.2
2000	878,066	3,000,000	41	22,394.7	39.2
2001	1,041,066	3,000,000	44	26,922.8	38.7
2002	1,270,456	3,000,000	47	24,940.5	50.9
2003	1,069,148	3,000,000	43	22,613.0	47.3

Table 2. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Northern Zone gillnet chub fishery 1981-2003.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT (x1,000 FT)	CPE
1981	241,277	200,000		4,920.4	49.0[a]
1982	251,832	200,000		3,469.8	72.5
1983	342,627	300,000		6,924.7	49.5
1984	192,149	350,000		6,148.4	31.2
1985	183,587	350,000		3,210.0	57.2
1986	360,118	400,000		7,037.2	51.2[b]
1987	400,663	400,000	23	6,968.6	57.5
1988	412,493	400,000	23	8,382.3	49.2
1989	329,058	400,000	25	8,280.8	39.7
1990	440,818	400,000	23	8,226.4	53.6
1991	526,312	400,000	22	9,453.5	55.7
1992	594,544	500,000	24	11,453.1	51.9
1993	533,709	500,000	24	15,973.6	33.4
1994	342,137	500,000	24	8,176.2	41.8
1995	350,435	600,000	24	5,326.4	65.8
1996	332,757	600,000	24	4,589.7	72.5
1997	315,375	600,000	23	4,365.6	72.2
1998	266,119	600,000	23	3,029.0	87.9
1999	134,139	600,000	23	1,669.7	80.3
2000	77,811	600,000	21	2,199.5	35.4
2001	36,637	600,000	21	972.4	37.7
2002	63,846	600,000	21	1,098.6	58.1
2003	102,692	600,000	21	2,326.5	44.1

[a] For the years 81-85, 90 & 91, 98-03 totals were by calendar year.
[b] For the years 86-89 & 92-97 the totals were through Jan. 15 of the following year.

Chub assessment in 2003 marked the second year that otoliths, a small piece of calcified material commonly referred to as ear stones, were extracted and used to age harvested chubs. This replaced the common scale reading method that had been used the past 25 years for aging purposes before 2002. The otolith method has been found to be more accurate, especially when dealing with older populations of fish.

Population assessments with graded-mesh gill nets were conducted in the fall of 2003 off Algoma, Baileys Harbor and Sheboygan with 2 lifts per port. One lift off Baileys Harbor was made in January due to weather constraints in November. Samples of chubs were also collected out of standard mesh gear fished off these ports. The use of otoliths for aging chubs indicates that scale reading may have under-aged fish in the last several years as chub growth slowed.

Fish over 20 years of age were collected off all ports with age 23 being the oldest (Figure 1). The population was dominated by fish older than 9 years of age, with ages 12 through 18 being the most common. We continue to see very few young fish in our assessment gear. Very few fish younger than age 8 were caught, with the youngest age fish being an age 5 off Sheboygan. Catches overall were again the best off Sheboygan, followed by Algoma with very low catches off Baileys Harbor. Chubs continue to show very little growth as they age (Figure 2). Very few fish ages 5 through 7 were caught, thus the large average size from our assessments for this age is skewed. As in the graded mesh, very few young fish were caught from standard mesh in the commercial gear (Figure 3). Ages 12 through 16 were the most common with chubs as old as 22 years of age being captured.

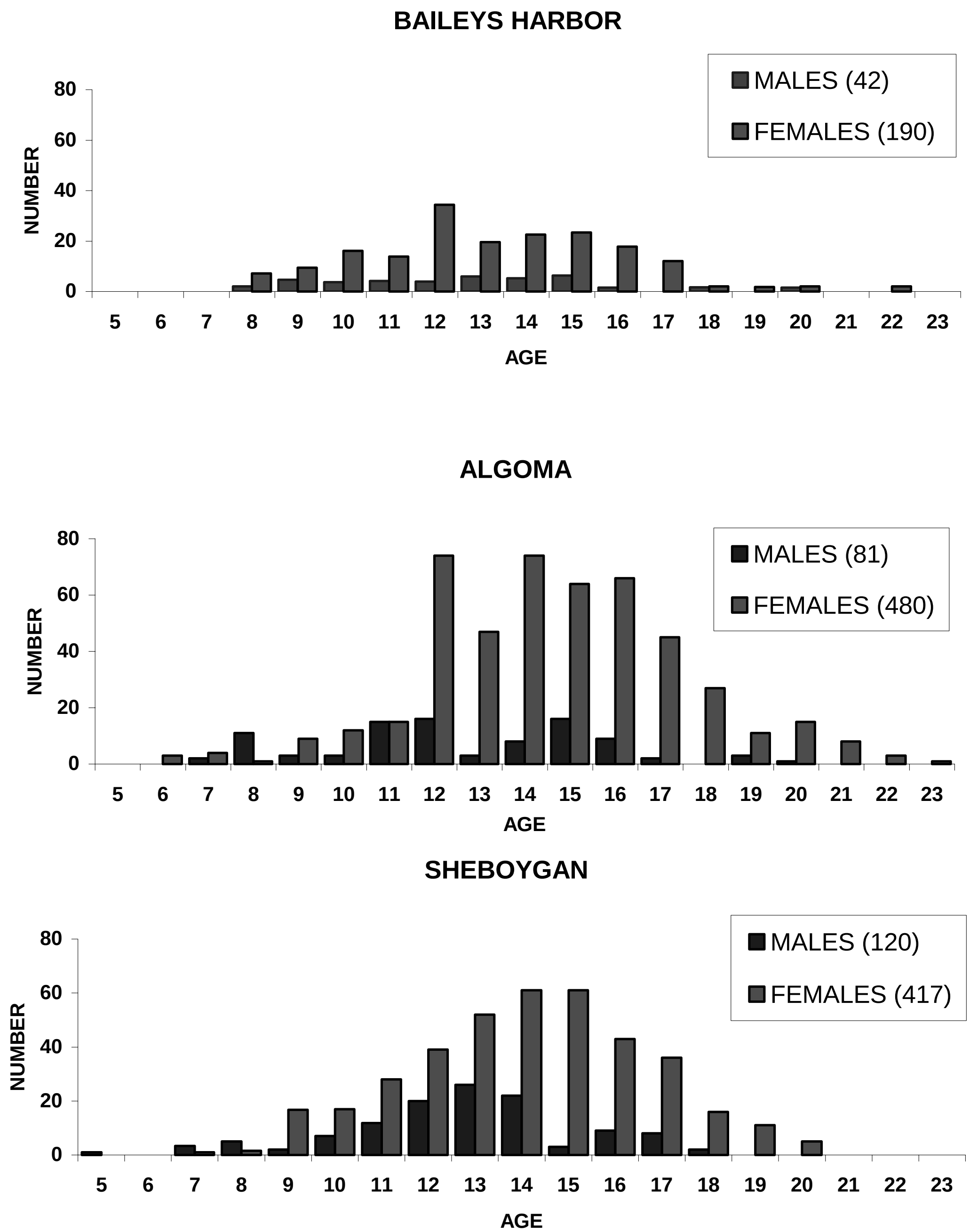

Figure 1. Age composition by number and sex of chubs captured during graded mesh assessments at three locations along the Wisconsin Lake Michigan shoreline, fall 2003.

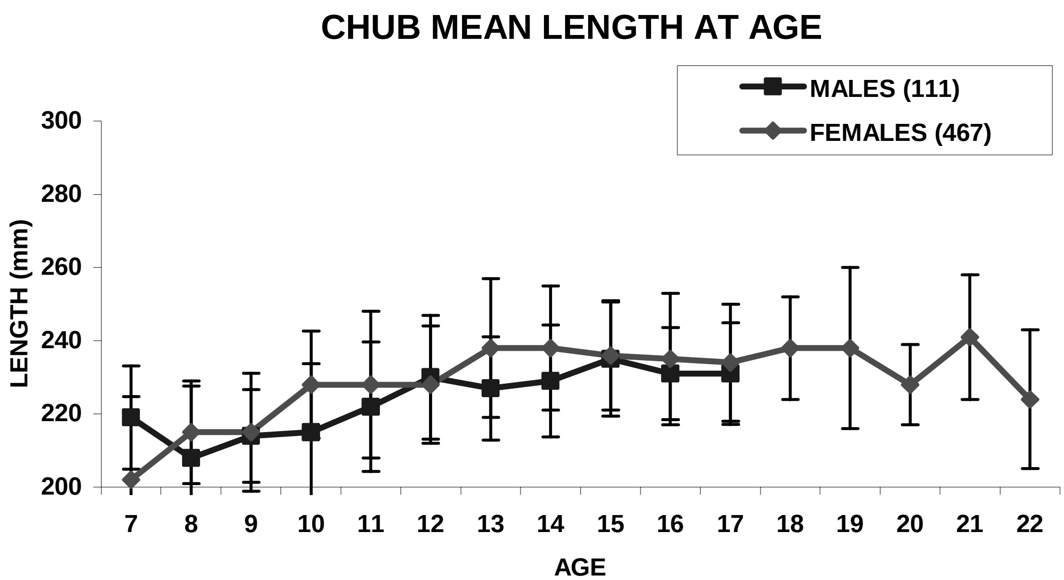

Figure 2. Average length (mm) and one standard deviation by age and sex for otolith aged chubs captured in graded mesh assessments in 2003 off Baileys Harbor, Algoma, and Sheboygan (chub data pooled from three locations).

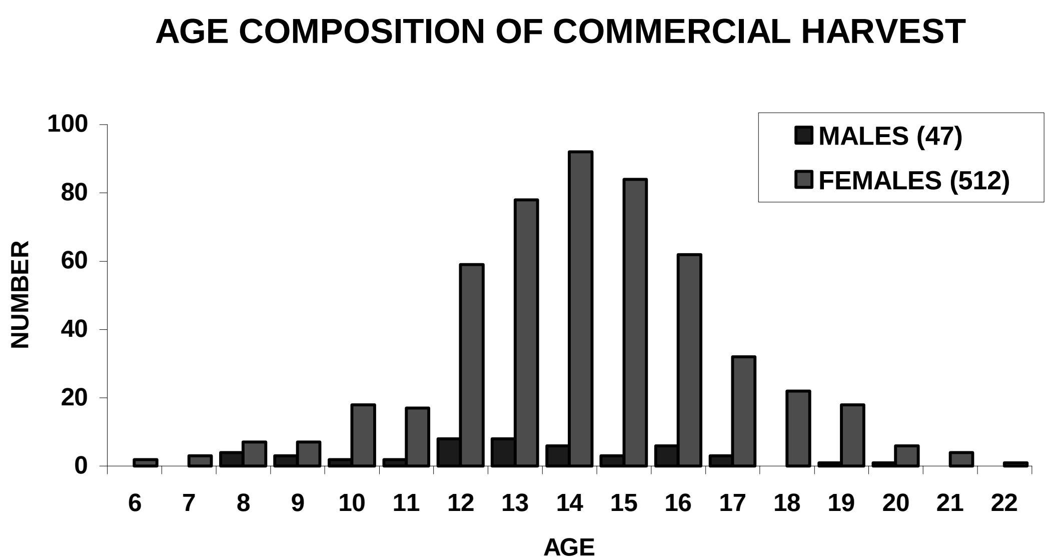

Figure 3. Age composition of chubs by number and sex sampled from commercial nets (2½” mesh) off Baileys Harbor, Algoma, and Sheboygan (data pooled) in 2003.

Sex ratios of chubs from standard and graded mesh continue to show a predominance of females, however, the gap decreased slightly from the last two years with a slight increase in percent males caught. In the graded mesh, 82% of the catch was female while the previous year catch resulted in an 87% female catch. Sex ratios in the standard mesh were 91% females compared to a ratio of 94% in 2002. An advantage of the female-dominated population to the commercial fishers is an added profit in the sale of chub roe to the caviar market during the late fall and winter months.

The following people were instrumental in varying aspects of this project: David Schindelholz for assistance with aging otoliths, and Pat McKee and Cheryl Peterson for data collection, entry and summary.

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STATUS OF THE LAKE WHITEFISH POPULATION

The reported commercial harvest of lake whitefish *Coregonus clupeaformis* from the Wisconsin waters of Lake Michigan (Figure 1) during quota year 2002-03 dropped to 1,323,002 pounds with 2.6 percent of the total harvest from pound nets, 71.0 percent in trap nets, and 26.4 percent in gill nets. The total annual quota of whitefish for Wisconsin commercial fisherman has been increased four times since it was first established at 1.15 million pounds in quota year 1989-90 and is currently at 2.47 million pounds.

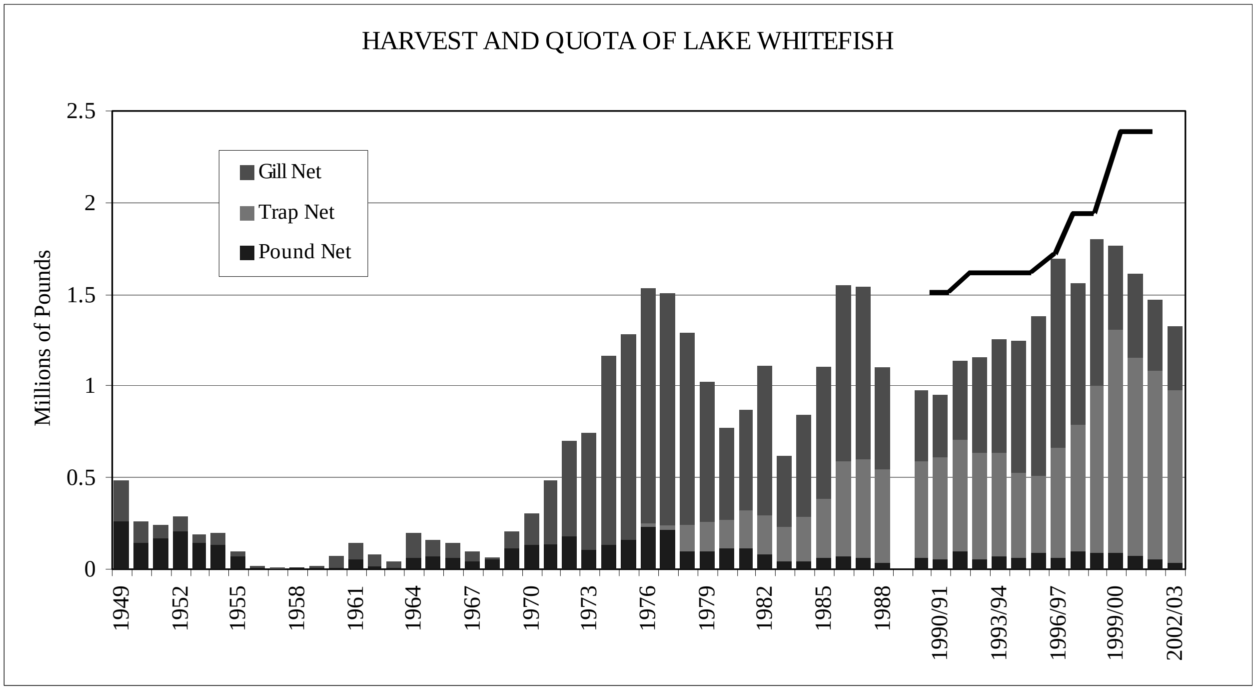

Figure 1. Lake Whitefish reported commercial harvest by gear in pounds (dressed weight) from Wisconsin waters of Lake Michigan including Green Bay, from 1949 through 2003. (Calendar years 1949 through 1988; quota years 1989-90 through 2002-03).

Wisconsin commercial fishermen have used trap nets as a legal gear to harvest lake whitefish from Lake Michigan since 1976. The use of trap nets has increased steadily and over the last 14 years has accounted for over 50 percent of the whitefish harvest. Over the last two years trap nets have accounted for over 70 percent of the lake whitefish harvest which is a direct result of more trap net effort and less gill net effort (Figure 2). Trap net effort is up to over 3,100 pots lifted per year, and gill net effort is down to less than 7 million feet fished per year. Catch per unit of effort (CPE) has shown a general downward trend over the last three to five years in all types of commercial gear (Figure 3), but, changes in seasonal whitefish distribution may have contributed to this decline.

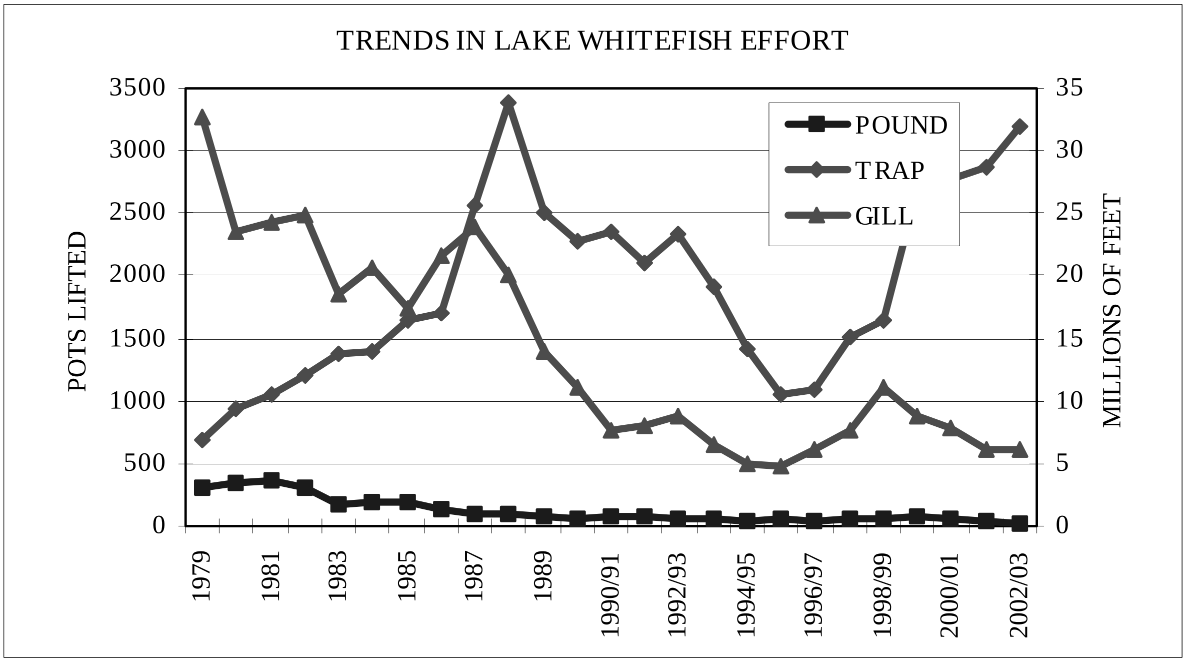

Figure 2. Trends in gillnet, trap net, and pound net effort fished for lake whitefish in Wisconsin waters of Lake Michigan, including Green Bay, 1979 through 2003. (Gill net effort = millions of feet; trap net and pound net effort = number of pots lifted).

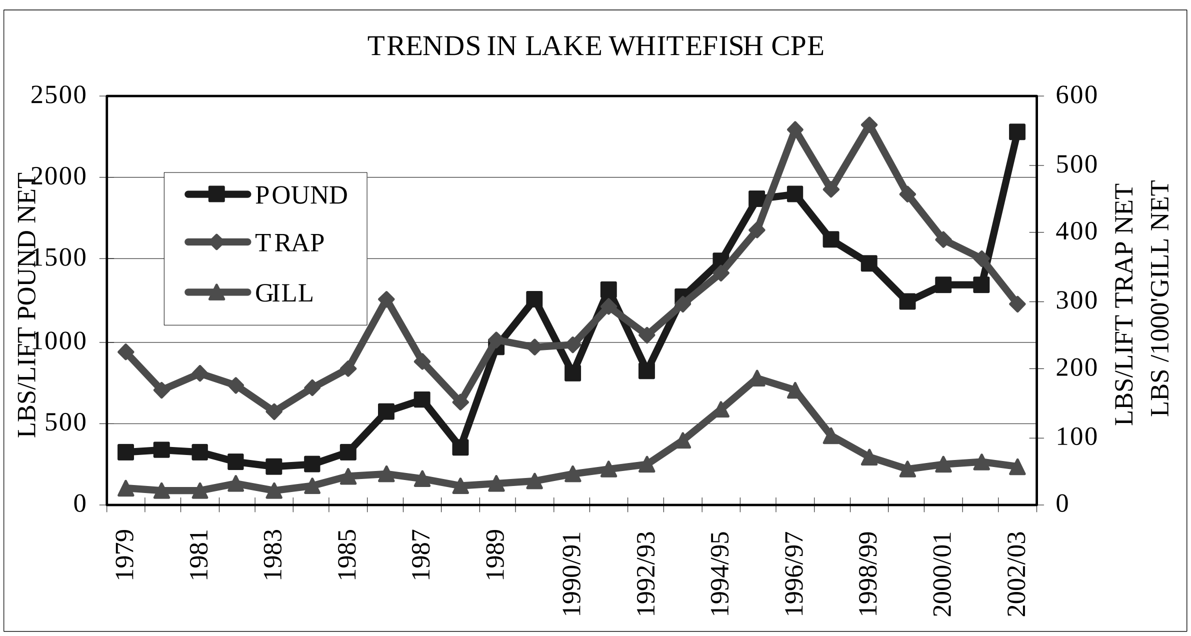

Figure 3. Trends in gill net, trap net, and pound net lake whitefish commercial catch per unit of effort (CPE) in the Wisconsin waters of Lake Michigan including Green Bay, 1979 through 2003. (Gill net CPE = pounds of whitefish harvested per 1,000 feet lifted; trap net and pound net CPE = pounds of whitefish harvested per pot lifted).

Initially, trap nets used by commercial fishermen in the Wisconsin waters of Lake Michigan and Green Bay, were restricted to waters less than 13 fathoms (78 feet). Meanwhile, Wisconsin commercial fishermen in Lake Superior and Michigan commercial fishermen were allowed to fish trap nets to depths of 15 fathoms (90 feet). In the Wisconsin Lake Michigan commercial fishery, whitefish catch per effort (CPE) in trap nets increased steadily through 1996, but then during 1997 and 1998, trap net fishers started to experience seasonal difficulty catching whitefish at depths where whitefish had been traditionally caught (Figure 4). Whitefish CPEs during the months of May, June, July, and August, dropped 36%, 60%, 69%, and 39% respectively from 1996 to 1998. There was a perception among the commercial industry that the reason for decreased trap net CPEs was the movement of whitefish to deeper waters. Concurrent with these changes was the rapid expansion of the zebra mussel population and noted increase in water clarity, increase in double crested cormorant numbers, and decline in diporeia numbers. When the trap net depth restriction was increased to 90 feet in 1999, trap net CPEs rebounded to near 1996 levels, but then fell again over the next several years.

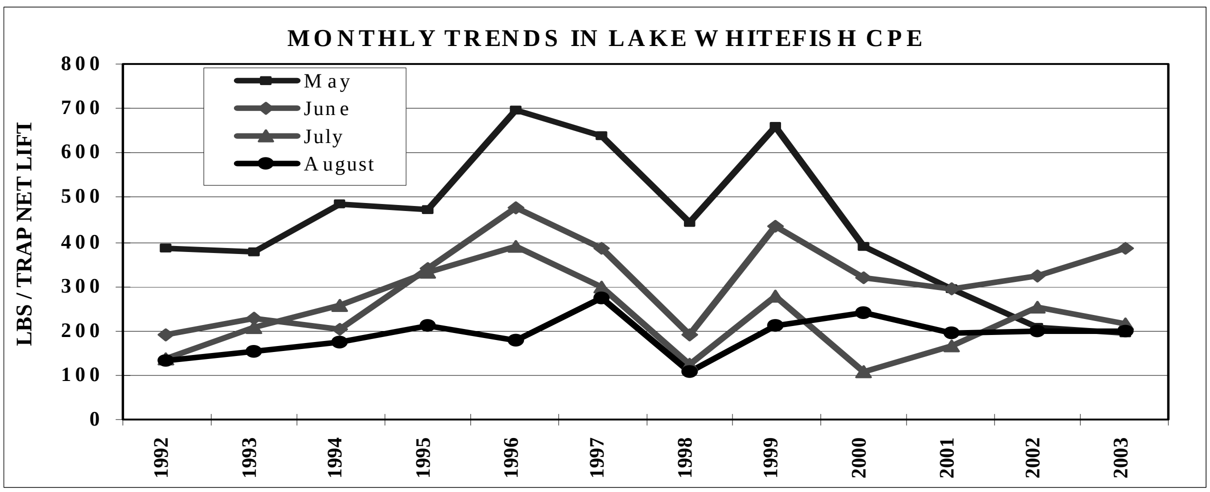

Figure 4. Monthly trends in Wisconsin commercial trap net CPEs 1992 through 2003. In the Wisconsin waters of Lake Michigan and Green Bay, trap nets were restricted to water less than 78 feet 1991 through 1998, and water less than 90 feet 1999 through 2001. In 2002 the depth to which trap nets could be fished was increased to 150 feet.

In response to requests for deeper trap net sets the Wisconsin Department of Natural Resources (WDNR), in cooperation with Wisconsin commercial fishers, conducted a study to evaluate the impacts of fishing trap nets to depths of 150 feet. Based on the results of this study, the WDNR has implemented a rule change that permits the use of trap nets to depths of 150 feet in 2002. In 2002 and 2003, trap net CPE continued downward in May while CPEs in June and July rebounded slightly, and August CPE remained relatively unchanged.

The mean length and mean weight of lake whitefish in the NMB population has experienced a steady decline. In spring 2003 whitefish mean length and weight at age (ages 2-5) were the lowest values documented since 1985 (Figures 5). As a result of the decreased length and weight at age, the age at which whitefish are recruited to the commercial fishery has increased from age four (as recently as the early to mid 1990’s) to age six.

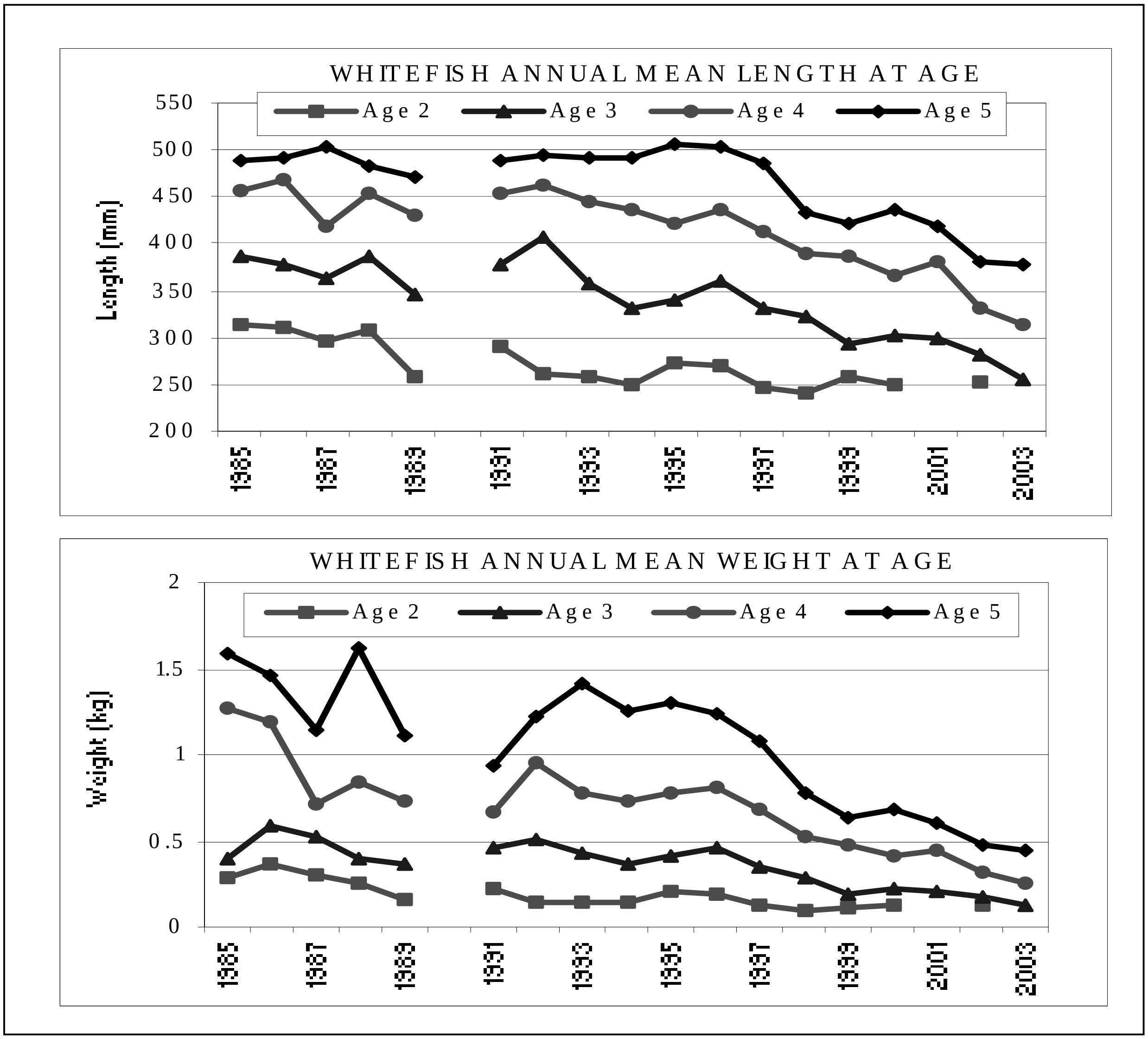

Figure 5. Mean length and mean weight of lake whitefish, at age, in spring, from the North/Moonlight Bay population, 1985-2003.

Another way to analyze the apparent decrease in mean length and weight at age is to follow individual cohorts as they age. Figure 6, illustrates the size at age of six recent cohorts from the NMB stock. When the 1988 year-class of whitefish from the NMB stock reached four years of age in the spring of 1992, it had a mean length of 462 mm and a mean weight of 0.96 kg. At this size the 1988 year-class was at least partially recruited to the commercial fishery and vulnerable to the gear being used. When the 1998 year-class reached age four in the spring of 2002 it averaged 331 mm and 0.31 kg. The minimum legal size for the commercial whitefish fishery is 432 mm. Only the fastest growing individuals from this cohort would have attained the minimum legal size.

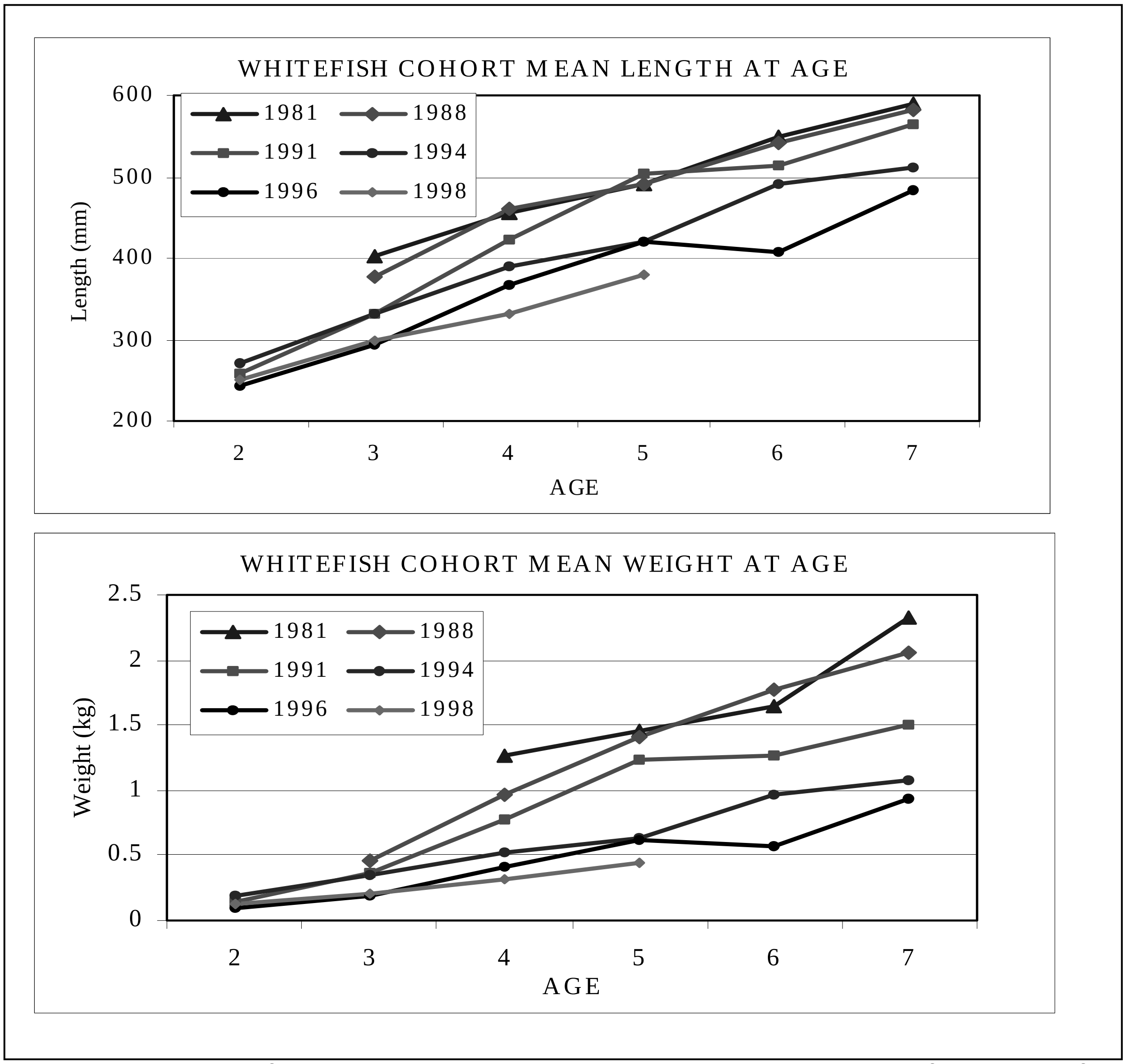

Figure 6. Comparison of the spring time, mean length and mean weight at age, of six cohorts from the North/Moonlight Bay stock of lake whitefish, 1981, 1988, 1991, 1994, 1996, and 1998.

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SMELT WITHDRAWAL BY THE COMMERCIAL TRAWL FISHERY

Historically, commercial trawling targeted three main species of fish in the Wisconsin waters of Lake Michigan. Much of the harvest was a general forage catch that caught large numbers of fish, chiefly alewife *Alosa pseudoharengus*, rainbow smelt *Osmerus mordax*, and bloater chub *Coregonus hoyi*. The other portion of the trawl fishery was a targeted rainbow smelt harvest. With the adoption of new rules in 1991 the general forage harvest component of the fishery was eliminated. Targeted rainbow smelt trawling rules have been established for the waters of Lake Michigan and Green Bay and the quota was set at 1,000,000 pounds, of which no more than 351,993 pounds could be harvested from Green Bay.

By utilizing the required biweekly catch reporting forms, it can be determined that commercial smelt trawlers reported catching 101,578 pounds of rainbow smelt during calendar year 2003 (Figure 1). This reported harvest was 34.5 % of the reported 2002 harvest and only 24% of the average harvest of the previous five years (1998-2002).

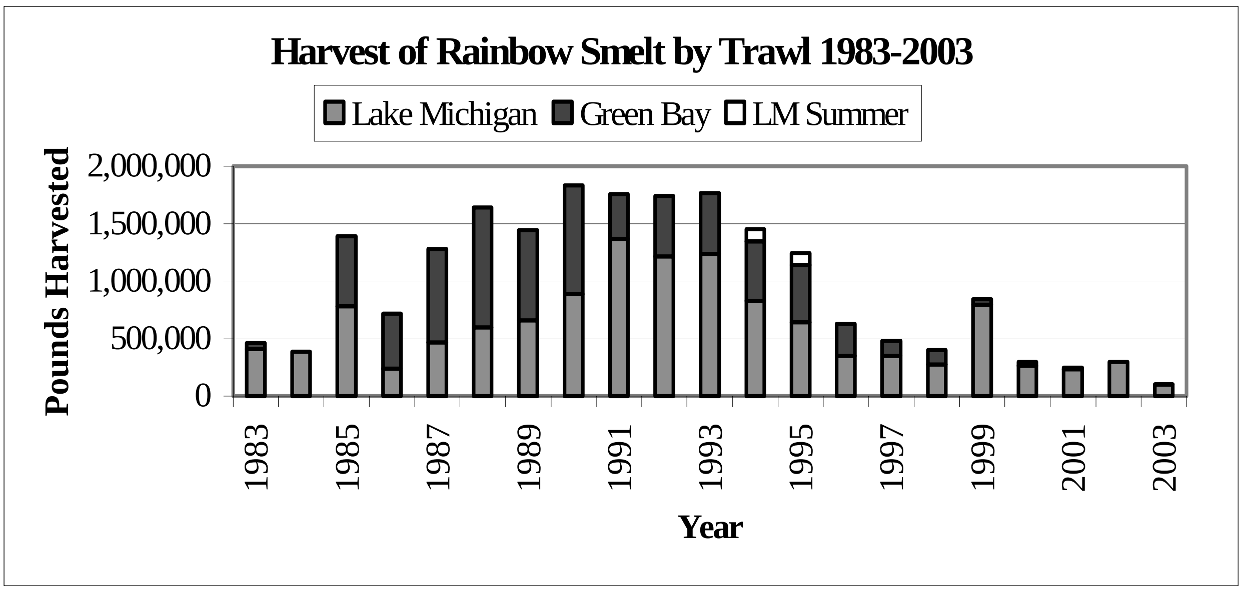

Figure 1. Reported rainbow smelt harvest by trawl from the Wisconsin waters of Lake Michigan for the years 1983 through 2003.

The harvest of rainbow smelt from Lake Michigan was 97,315 pounds (Figure 1), with an average CPE of 85 pounds per hour trawled (Figure 2). The 2003 Lake Michigan rainbow smelt harvest was the lowest on record and continued the trend of declining harvest in the fishery. The calendar year 2003 harvest represented only 26.2% of the average harvest of the previous five years from Lake Michigan. CPE on Lake Michigan declined to 85 pounds per hour trawled, the lowest on record since 1983.

Commercial trawlers on Green Bay reported a rainbow smelt catch of 4,263 pounds (Figure 1), with a CPE of 127 pounds per hour trawled (Figure 3). The 2003 rainbow smelt harvest on Green Bay although substantially higher than the 2002 harvest of 127 pounds, was the second lowest reported harvest (2002) and only 9.6% of the average catch of the previous five years. Although CPE improved from 14 pounds per hour trawled in 2002 to 127 pounds per hour trawled this year, total effort still remains very low when compared to total yearly effort of the mid 1990's.

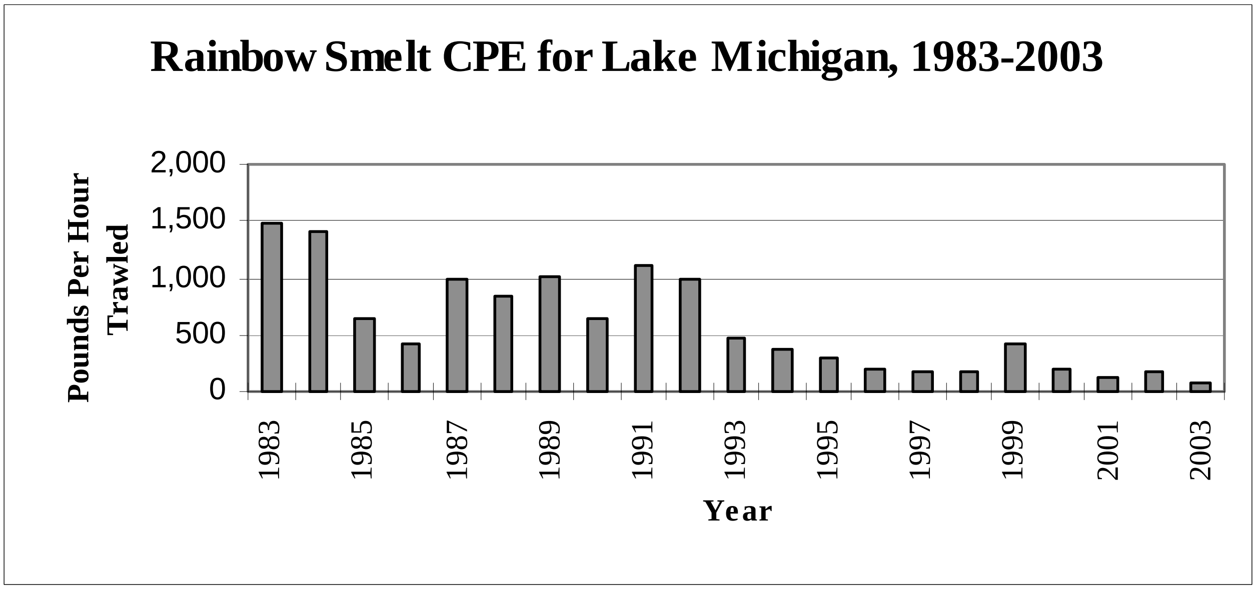

Figure 2. Rainbow smelt CPE in pounds per hour trawled on Lake Michigan during the years 1983 through 2003.

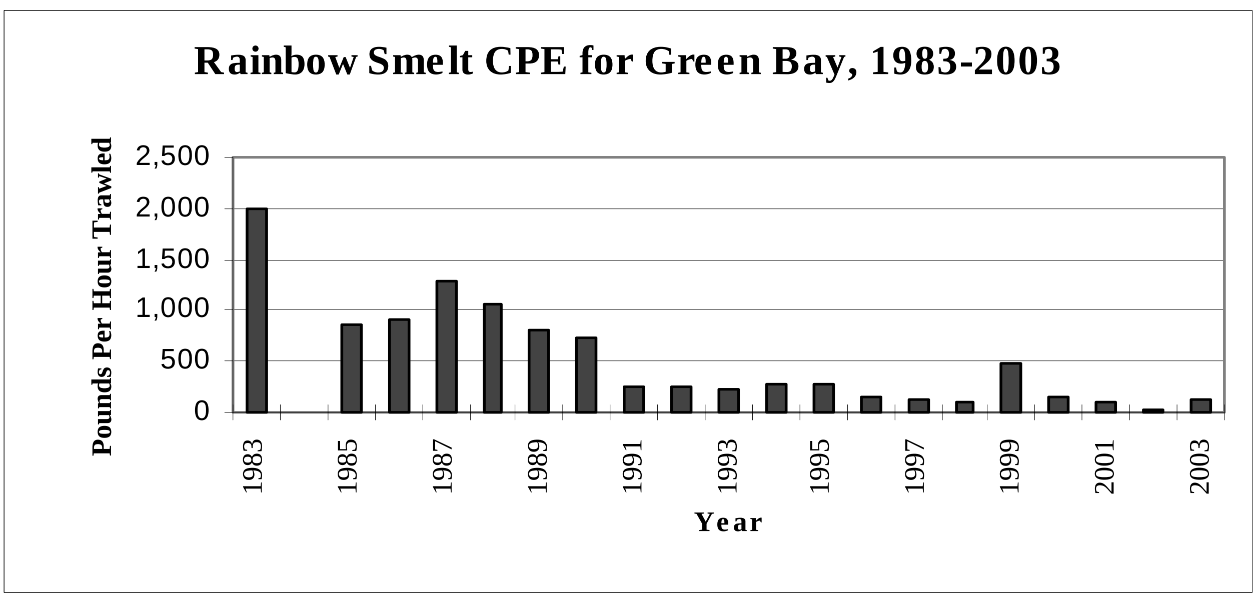

Figure 3. Rainbow smelt CPE in pounds per hour trawled on Green Bay during the years 1983 through 2003.

The commercial rainbow smelt harvest has declined dramatically since peaking in the early 1990's and had reached a substantially lower, but stable level since 2000. However, in calendar year 2003, there was a sharp decline in total harvest and harvest from Lake Michigan while the harvest on Green Bay improved from 2002 harvest lows. Declines in Lake Michigan rainbow smelt harvest by commercial fishers is likely due to the decline in lakewide abundance of rainbow smelt. Harvest on Green Bay during the summer of 2003 occurred mostly during a two or three-week period during August when the fish were schooled together and likely does not indicate an increase of rainbow smelt abundance on Green Bay.

Except for 1999, when trawlers reported an increase in rainbow smelt harvest numbers not forecasted by the U.S.G.S. in 1998, the harvest of rainbow smelt by commercial trawlers has been similar to population trends determined by the U.S.G.S from their fall index trawling. Sharp declines in rainbow smelt harvest and CPE since 2000 by trawlers seem to indicate that 1999 was an unusual harvest year and that lakewide rainbow smelt numbers remained depressed from past levels. Recent U.S.G.S trawl data does not indicate any major change in lakewide rainbow smelt abundance, so it is likely that commercial harvest will not substantially change in the near future.

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STATUS OF WALLEYE STOCKS – LOWER GREEN BAY

Abundance

The adult spawning population of walleye in the Fox River for the spring of 2003 (age 3 and older; and greater than 370 mm, Figure 1) was estimated at 10,214 (95% CI 8,309-12,551). This estimate was a slight improvement over the 2002 estimate of 8,058, but still was substantially lower than the preceding ten-year average of 24,875 adult walleye. The 2003 estimate is the second lowest spawning population estimate of the last seventeen years. Continued low water levels on Green Bay have compromised our ability set nets in appropriate locations or may have also disrupted normal walleye spawning behavior although spawning during 2003 appeared to be normal. Poor 1999 and 2000 year-classes and a relatively poor 1998 year-class also may be contributing to the low spring spawning abundances observed the past two springs. We still believe that harvest is not contributing to the low abundance. Assuming a majority of the walleye from lower Green Bay and the Fox River are spawning in the river, anglers harvested less than two percent of the estimated 10,214 adult walleye spawning during the spring of 2003.

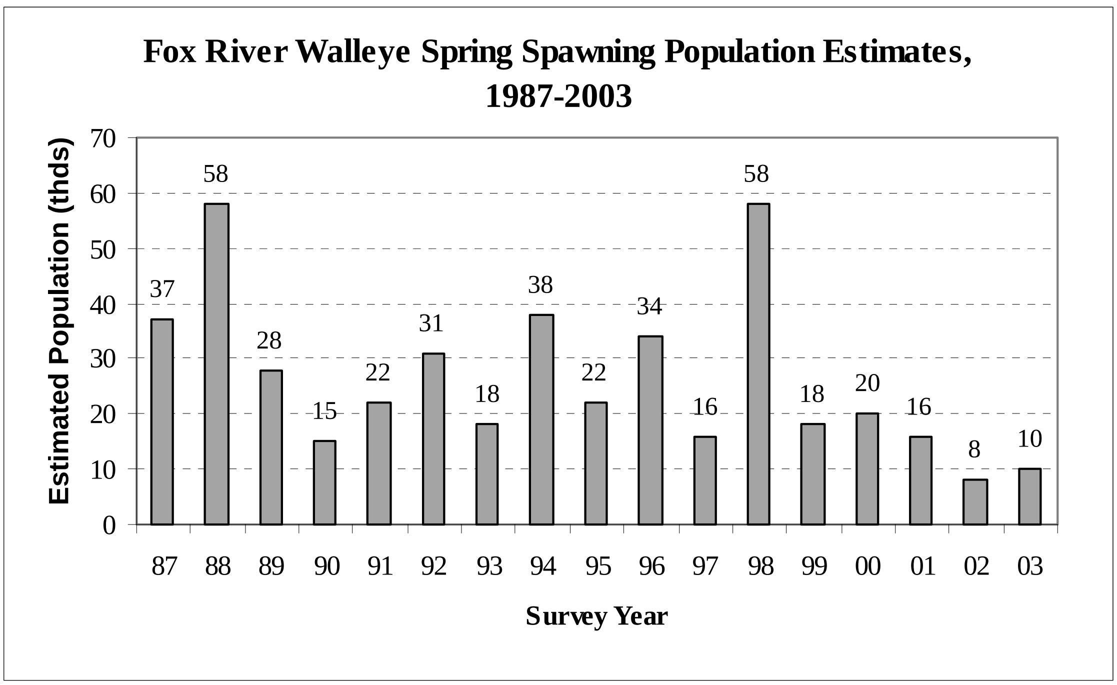


Figure 1. Spawning population estimates of Fox River adult walleye greater than 370 mm in length (ages three and older) from surveys conducted between 1987 and 2003.

Recruitment

We estimate that only 613 three-year-old male walleye were recruited to the spawning population in survey year 2003 (Figure 2). The 2000 year-class of male walleye was the second poorest in seventeen years of spawning assessments. This was somewhat predictable, however, because the year-class, as measured as fall YOY in 2000, was shown to be the fourth worst since we began conducting fall surveys in 1987 (Figure 3).

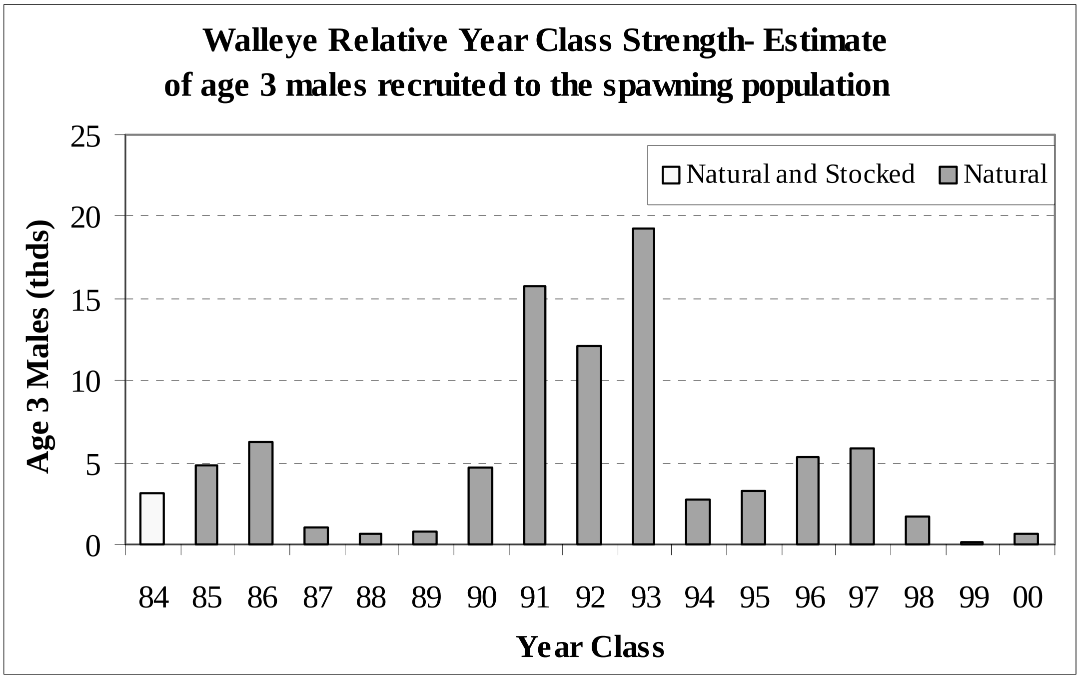


Figure 2. Relative year-class strength of Fox River walleye as measured by the estimated number of age three walleye recruited to the adult spawning population from surveys conducted in 1987-2003.

Age Structure

Age 2 males (2001 year-class) comprised the most abundant male cohort measured during the spawning assessment in 2003, and represented 54.7% of all male walleye captured (Table 1). It appears the abundant YOY walleye captured in 2001 have survived well and bodes well for future populations, as these fish will recruit into the spawning population in 2004. Age 5 males (1998 year-class) comprised the next most abundant cohort captured during the spring assessment. Age 2 walleye averaged 337 mm in length and had an average weight of 0.4 kg. Age 5 males had an average length of 490 mm and weight of 1.1 kg.

Age 7 females (1996 year-class) were the most abundant female cohort captured during the spawning assessment in 2003 followed by Age 6 and Age 5 walleye (Table 2). Age 7 walleye had an average length of 610 mm and an average weight of 2.7 kg. Age 6 females averaged 576 mm and 2.1 kg. Based on YOY fall surveys, we expected the age 5 females to be better represented, but they only represented 19.7% of adult females captured during the spring assessment in 2003.

Table 1. Age Distribution (%) of Male Spawning Walleye – Fox River 1998-2003

Age	2	3	4	5	6	7	8	9	10	11	12	13+
1998	2.0	16.8	35.5	37.2	6.2	1.6	0.4	0.0	0.1	0.1		
1999	3.3	53.2	10.4	20.5	9.5	2.0	1.0					
2000	11.5	48.7	26.3	9.7	3.1	0.5	0.2					
2001	0.4	20.5	41.6	20.3	12.0	3.4	0.6	0.4	0.6	0.2		
2002	1.6	7.7	29.3	22.0	20.7	8.9	5.3	1.6	1.2	1.2		.04
2003	54.7	5.4	9.3	17.6	9.7	2.2	0.7	0.2	0.2	0.1		

Table 2. Age Distribution (%) of Female Spawning Walleye – Fox River 1998-2003

Age	2	3	4	5	6	7	8	9	10	11	12	13+
1998		1.0	14.1	25.3	30.6	15.3	5.2	2.6	3.4	1.0	0.5	0.9
1999			4.0	32.9	22.1	19.1	8.9	4.6	2.7	3.8	1.3	0.5
2000		1.8	26.1	27.9	27.3	10.9	2.6	0.9	1.7	0.6		
2001		6.0	10.8	33.6	16.3	9.8	10.0	6.0	2.7	2.7	1.6	0.5
2002		0.2	17.7	17.3	21.0	10.0	12.3	12.5	4.4	2.7	0.6	1.2
2002		0.5	1.0	19.7	23.2	26.9	16.9	10.7	0.5	0.1	0.4	

Recruitment of YOY

In 2003, results of the fall electrofishing survey have shown YOY survival to the fall fingerling stage to be the third highest we have measured since 1987 (Figure 3). The 2003 year-class appears to be in the same range of magnitude as the 1993 year-class, but still much less than the 1991 year-class. The 2003 recruits along with recruits from the 2001 and 2002 year-classes should over the next several years recruit to the spawning population. On this basis we remain cautiously optimistic that the adult population of walleye will recover from the low abundance seen in the spring 2002 and 2003 surveys.

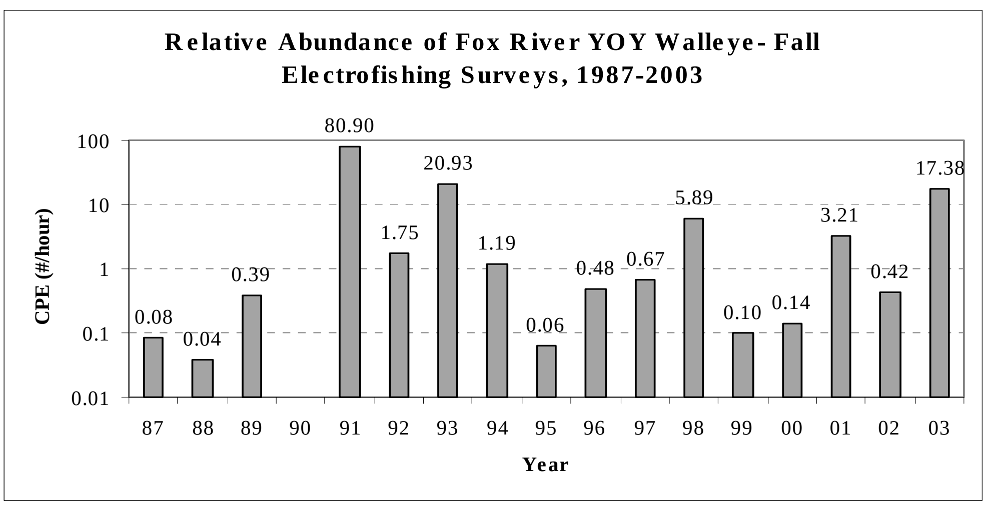
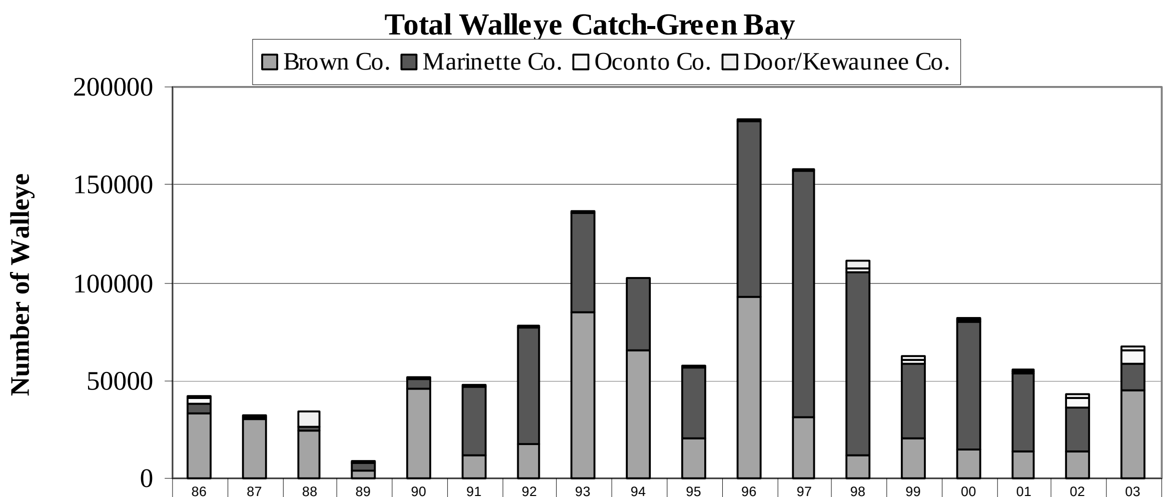


Figure 3. Relative abundance of YOY walleye in the Fox River as measured by catch per unit effort (CPE) from data collected in electrofishing surveys for years 1987-2003.

Catch and Harvest

The walleye catch for Wisconsin waters of Green Bay was estimated at 67,500 walleye during the open water season in 2003 increased from 43,000 caught in 2002 which is a 57% increase (Figure 4). The increase in catch in 2003 reversed a two-year trend of declining catches on the waters of Green Bay. Catch declined in the Green Bay waters of Marinette County but increased in all other areas around Green Bay. The 2003 catch in Brown County more than tripled the estimated 2002 catch. Catch in Oconto, Door and Kewaunee Counties increased more modestly.

Total harvest on Green Bay increased from 15,000 walleye in 2002 to 21,237 Bay wide in 2003 (Figure 5). Brown County's harvest increased by 4 times to 3,936 and Door/Kewaunee County's harvest increased 9 fold to 2,062. Walleye harvest in Marinette County increased by 19% to 10,670 while harvest in Oconto County declined by 10% to 4,569.



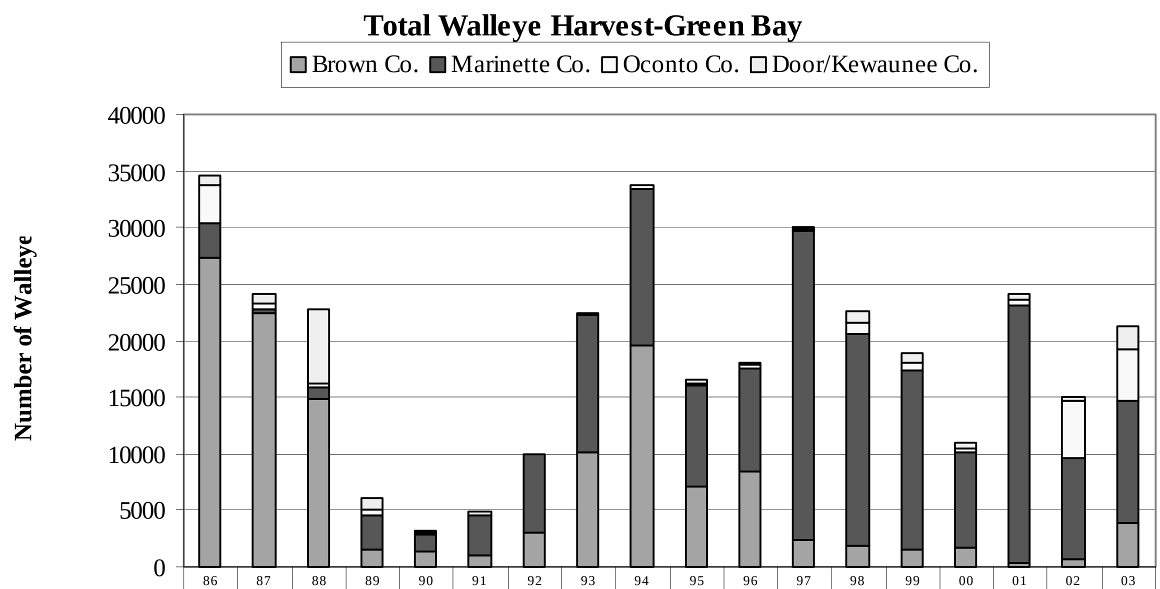
	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03
Door/Kewaunee Co.	878	905	7520	900	661	744	0	178	223	436	759	335	4147	2047	562	1140	1539	2555
Oconto Co.	3331	533	284	613	137	0	362	439	387	382	633	443	2284	2569	659	681	5750	6050
Marinette Co.	4868	691	1877	4023	5330	34987	59987	50383	36864	36193	89339	125864	93871	37216	65318	39810	21891	14341
Brown Co.	33124	29758	24409	3457	45648	11961	17515	85341	65190	20565	92915	31632	11354	20849	14953	14052	13779	44554

Year

Figure 4. Total walleye catch for Wisconsin waters of Green Bay by County for the years 1986-2002

The near future of the walleye population on the Fox River and lower Green appears to be good. Surveys in 2003 indicated that on the Fox River the spawning population had increased from the previous year, recruitment of 3 year males increased and the 2003 abundance of YOY walleye as measured in fall was the third highest on record. Good year-classes in 2001, 2002 and 2003 that recruit into the fishery from 2004 to 2006 for males and beyond for females, should result in many more spawning walleye in the near future.

Walleye anglers fishing the waters of Green Bay had a good year with overall increases in catch and harvest in 2003. With the upcoming good year-classes of walleye that were observed during surveys, angling for walleye on Green Bay should good in the near future.



	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03
Door/Kewaunee Co.	878	733	6596	900	249	332	0	91	98	234	192	217	1132	763	465	601	218	2062
Oconto Co.	3243	533	284	555	105	0	47	178	237	235	296	203	1031	806	281	392	5143	4569
Marinette Co.	3067	363	1039	3023	1468	3489	6864	12086	13863	8941	9072	27264	18750	15778	8511	22937	8980	10670
Brown Co.	27367	22436	14891	1552	1409	1089	3074	10122	19627	7109	8455	2422	1784	1530	1688	263	617	3936

Figure 5. Total walleye harvest for Wisconsin waters of Green Bay by County for the years 1986-2002

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YELLOW PERCH – SOUTHERN GREEN BAY

Yellow perch abundance in Green Bay increased steadily through the 1980's and has declined since then. The population growth was fueled by the production of strong year-classes in 1982, 1985, 1986, 1988, and 1991 (Figure 1). Since 1991 there had been only one moderately strong year-class that appeared in 1998, until 2003 when we observed an extremely strong abundance of young-of-the-year. The estimated total biomass of yearling and older yellow perch rose from under 1,000,000 pounds in 1980 to over 10 million pounds in 1988, and then declined through the 1990's to an estimated biomass in the year 2000 of less than 500,000 pounds.

The decline in the population during the 1990's can be attributed to poor recruitment of young-of-the-year fish, as assessed in the late summer of each year (Figure 1). Following over a decade of good production of young fish, we have seen only one reasonably strong year-class (1998) and one extremely large year-class (2003) since 1991. The hopeful 1998 year-class was abundant as 1 year olds in our trawl survey in 1999 and has been seen as the strongest year-class through 2002. During 2001 and 2002 the majority of both the commercial and sport harvest has been comprised of the 1998 year-class, 88% and 81% respectively were from the 1998 year-class (Table 1.). In 2003 the commercial harvest was split between the 1998 (43%) and the 2000 (34%) year-class with an obvious lack of the 1999 (6%) year-class.

Population assessment

Yellow perch spring spawning sampling continued for it's 26th year on Green Bay at Little Tail point. Two double-ended fyke nets were set on April 21st with an additional double-ended net added on April 23rd. All nets were fished until April 29th. A total of 667 mature females, 107 immature females, 1,674 mature males, and 13,378 yearlings were sampled. A high percentage of the yearlings that were sampled were mature males.

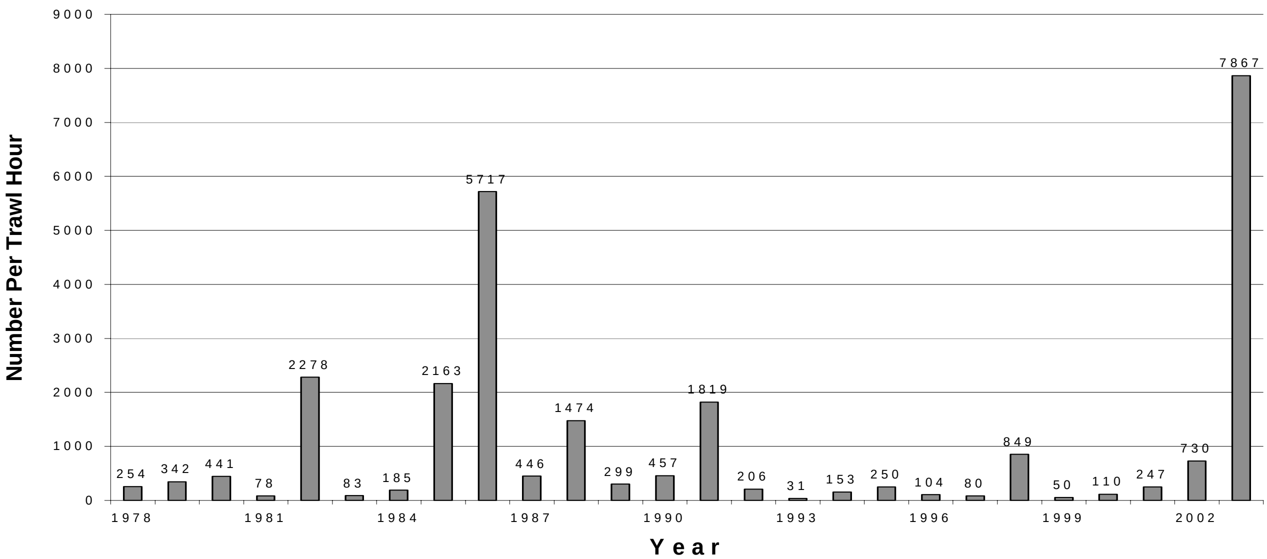
In 2003, larval sampling continued at a lower intensity than in previous years, with support from Sea Grant for equipment and a boat. Larval sampling was conducted using a High Speed Miller Sampler at one location north of Oconto and at two locations off of Little Tail Point, every four days from May 5th through June 13th. Samples were sent to Sea Grant for analysis. Visual observations showed extremely high numbers of larval yellow perch present in the samples.

Index station seining continued for the 22nd consecutive year at 15 sites spread over 130 miles of Green Bay shoreline. Seining was carried out on the week of June 23-25, June 30-July3, and July 14-16. The average numbers of yoy per site were 56, 148, and 40 respectively and the percent of sites with yoy were 71%, 87% and, 93% respectively.

Annual late summer trawl surveys continued for the 26th year. Designated index sampling locations are used to monitor trends in abundance and to estimate mortality rates of individual year-classes. In 2003 index trawling continued at the 78 index trawling stations, at the standard sites established in 1978 and at the additional deep-water sites that were added in 1988. The 32 deeper sites were developed as a result of a trend of increasing abundance of yellow perch observed at a single deep site (off Marinette) established in 1985. Standard and deep site information has been combined based on the amount of habitat they represent and an adjustment made for standard site information prior to 1988 to account for the increasing area of occupancy, creating a weighted area average value.

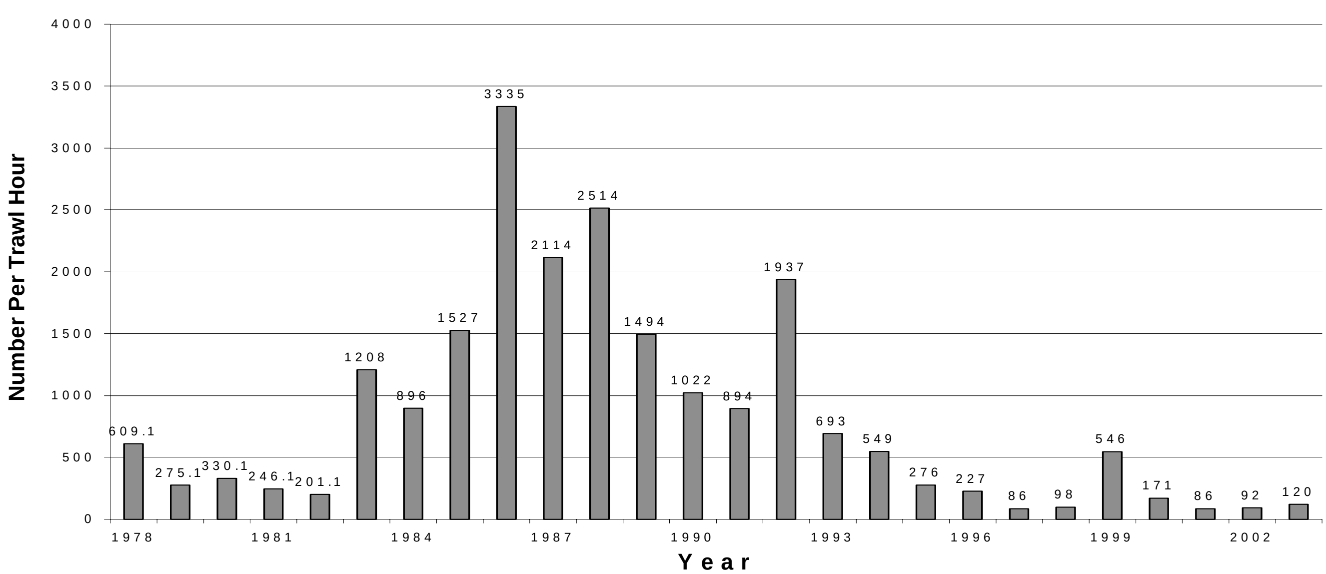
In 2003 the number of yoy yellow perch caught per trawl hour (7986) ranked as the highest in the past 26 years since index sites were established in 1978. Figure 1. Shows the catch per trawl hour for yoy from 1978 to 2003.

Figure 1. Relative Abundance, Age-0



Yearling and older yellow perch abundance increased at index station sites from 2002 to 2003 (Figure. 2). The weighted area average was 120 age1and older yellow perch per trawl hour in 2003. However, the catch for 2003 was still the fifth lowest since 1978 and well below the 26year average of 829 perch per trawl hour.

Figure 2. Relative Abundance, Age-1 and Older



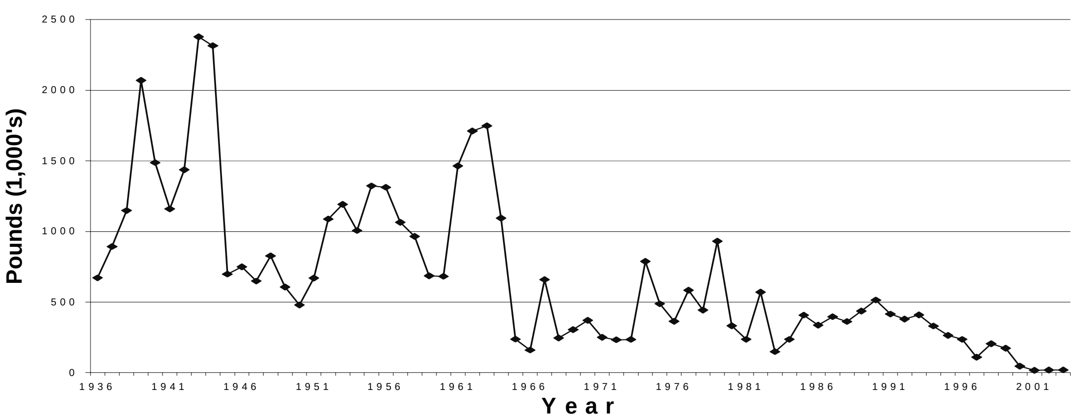
Harvests

The annual commercial harvest is reported by fishers, and fish sampled at the dock from commercial landings are used to describe the age and size composition of the catch.
The annual sport harvest is estimated using a creel survey, and fish obtained through the survey are used to describe the age and size composition of the catch.

Since the 1983-1984 commercial fishing license year, the yellow perch commercial harvest in Green Bay has been managed under a quota system. Quota shares are allocated to individual licenses based on their harvest for four years prior to the establishment of the quota. The license year quota runs from July 1st to June 30th. The zone 1 (Green Bay) quota has ranged over the past decade from the current low of 20,000 pounds to a high of 475,000 pounds.

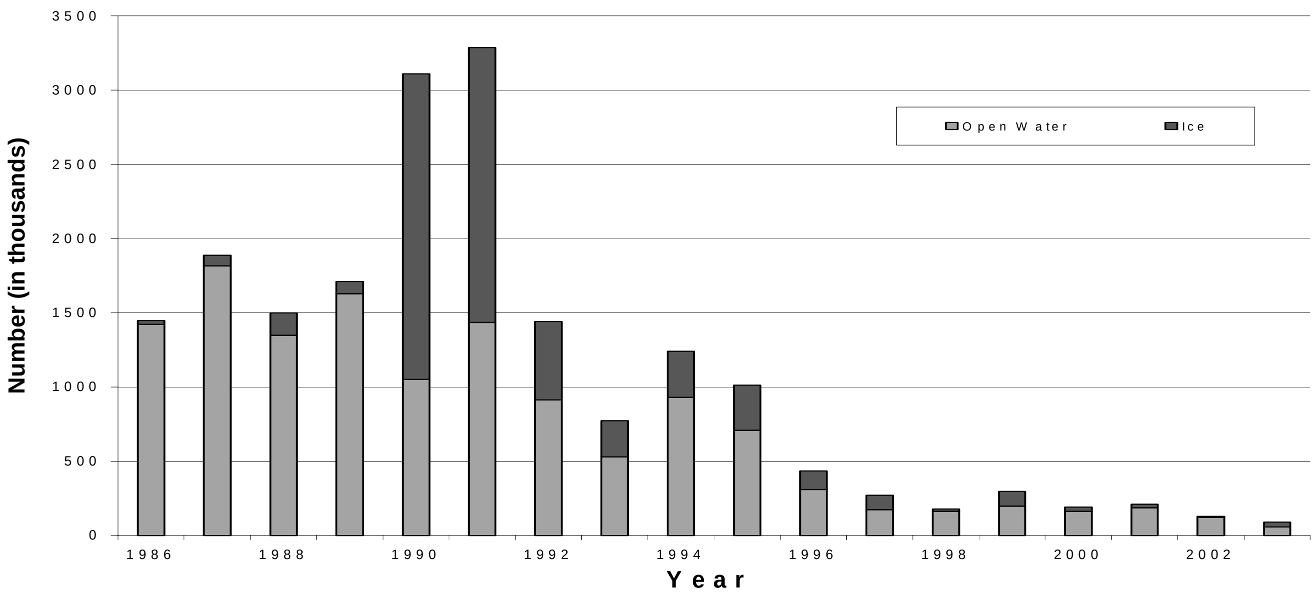
During the commercial fishing year 2002/2003 commercial fishers harvested almost all of their allotted limit of 20,000 pounds they harvested a total of 19,611 pounds (Figure 3). During 2003 both a gill net and a drop net fishery took place, with drop nets only being fished in late August, September and October.

Figure 3. Commercial Yellow Perch Harvest



Sport fishing harvests have also risen and fallen with changes in yellow perch abundance. Sport harvest peaked at over 3,000,000 fish in 1990 and 1991, when unusual ice conditions and large numbers of fish allowed the estimated harvest of 2,000,000 yellow perch through the ice each year. By the year 2001 the sport harvest had declined to an estimated 210,489 yellow perch in total, with only 24,891 being taken through the ice (Figure 4.). During 2003 catches were found to decline again to 89,487 yellow perch in total with 32,366 being taken through the ice (Figure 4.). The current bag limit on yellow perch is at 10; this is the lowest bag limit during the history of the Green Bay creel program.

Figure 4. Estimated Sport Harvest



Management Plans

Although the 2003 year-class appears to be the best on record, its survival through maturity is unknown. The Department has recommended retaining current harvest regulations at least until July 1, 2006.

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YELLOW PERCH - LAKE MICHIGAN

The 1998 year-class yellow perch, which supported the fishery for several years, is declining rapidly in the Wisconsin waters of Lake Michigan. No other year-class has contributed substantially since 1998. This report is a summary of the status of young and adult perch in Lake Michigan assessed through several annual assessments in Wisconsin waters during 2003-04.

Beach seining

In southeastern Wisconsin, beach seining was done to assess young of the year (YOY) yellow perch. In 2003 we sampled at sixteen sites between Kenosha and Sheboygan from August 25, 2003 to September 9, 2003 using a 25' bag seine with ¼" delta mesh. Lower lake levels posed challenge in some of the sites. Surface water temperature averaged at 70 ^{0}F. Catch per effort (CPE) is calculated as the mean number of YOY perch per 100-ft seine haul. This number is used as an index of year-class strength. Figure 1 shows the catch per effort of YOY yellow perch for the sites in the Southeast Region (SER) since 1989. No YOY yellow perch were captured in 1994 sampling as well as 1999 sampling. In our 2003 survey, we capture 6 YOY yellow perch with an overall CPE of 0.1, which indicates another year of poor reproductive success. The size range of YOY yellow perch was 39 mm to 68 mm. By and large, YOY alewife dominated the catch followed by spottail shiner and longnose dace.

In addition to using a standard bag seine, a modified Swedish monofilament gill net was used to capture YOY yellow perch in the nearshore waters. The net consisted of four panels, each 10 ft long and 5 ft deep, with varying mesh sizes – 6.25mm, 8mm, 10mm and 12mm. They were set on rocky bottom in approximately 4-6 ft of water. The nets were allowed to fish for one night. The majority of YOY yellow perch were captured in 6.25mm mesh. A few yearlings were present in the bigger mesh indicating that some 2002 year-class made it through the winter. We could not determine the CPE because filamentous algae fouled the nets.

Spawning Assessment

This assessment has been conducted on the Green Can Reef and in the Milwaukee harbor since 1990 (Table 1). The objective is to quantify the relative abundance of mature female perch in previously identified spawning areas. We took first gillnet lift on 5/28/2003 at depth range 31-65 ft. with a total effort of 1250 ft. net. A total of 894 yellow perch were captured of which 15 were females. Only 2 out of 15 females were ripe at this time. The bottom water temperature was 47 ^{0}F. The majority of the yellow perch captured came from nets set at 31-32 ft. of water. The second lift was taken on 6/3/2003 when the water temperature was still 46 ^{0}F at the bottom. A total of 715 (11 females) yellow perch were captured in 450 ft. of gillnet. At this time, 7 females out of the 11 were spent, and 3 were green. We collected anal spines from 50 males and 27 females for age determination. Overwhelming majority of the yellow perch (94%) on the spawning reef belonged to 1998 year-class.

Yellow perch egg deposition survey was conducted by the WDNR dive team on 6/5/2003. Number of egg skeins per 1000 m^2 was 10.04 in 2003 compared to 11.53 per 1000 m^2 in 2002.

Graded Mesh Gill Net Assessment

The WDNR conducts standardized graded mesh gill net assessments annually in the winter, in grids 1901 and 1902 off Milwaukee. The mesh sizes used in these assessments run from 1 to 3 inches stretch on 1/4 inch increments. Yellow perch begin to recruit to this assessment gear by age 2 and are fully recruited by age 3. A total of five lifts, each with 2800' effort were taken from 12/18/2003 to 2/24/2004 at depth ranges from 52' to 85'.

Table 2 shows the relative abundance as catch per effort of perch, by age, for this assessment from 1989 through 2004. The data show variability in catch rates by calendar year. These data show very low CPEs of older fish and higher CPEs of younger fish until the late 80s. Almost the entire 90s had very low numbers of age 3 and under, while the population was skewed toward older male perch. However, data on age and size distribution of yellow perch from 1999 onward represented smaller and younger perch in significant proportions, essentially from 1998 year-class (Table 2). The proportion of age 6 and older perch has been extremely reduced to almost zero, so is perch younger than age 6 (Fig. 2). This was due to a combination of poor recruitment and mortality (both fishing and natural) of older fish. The fast growing 1998 year-class seems to have recruited to the fishery at the end of age 2 with strong showing until recently. However, the 1998 year-class yellow perch appear to be disappearing from the population very fast. The average size of age 6 male was 264 mm (total length) and female was 306 mm (total length). Since 2000 the sex ratio of the yellow perch population got shifted toward predominantly female and lasted until 2002. This trend is reversed again since 2003 with greater number of males. The overall catch comprised 87% of age 6 yellow perch representing the 1998 year-class. The oldest yellow perch recorded was a 14 year old female (283mm total length).

Harvest

In September 1996, the commercial yellow perch fishery was closed in the Wisconsin waters of Lake Michigan. Hence, the information on commercial harvest is limited up to 1995 catches. Sport harvest is monitored by a contact creel survey. The sport bag limit has been reduced to 5 fish/day in recent years, which is reflected in the total harvest (Table 3). Our creel survey data on the sport caught yellow perch indicated that the majority of catch consisted of a single year-class. The 1998 year-class dominated the sport harvest in 2001 representing 86.5% of the catch. Similar trend is evident from the 2004 winter graded mesh assessment that the1998 year-class comprised 87% of the catch. Overall sport harvest has decreased significantly in 2002 producing only 98,000 yellow perch compared to 134,000 in 2001. It is further reduced in 2003 by producing only 88,778 yellow perch. Because of the decreased density, the perch seem to be growing at a faster rate and attaining larger size at age, and hence the larger individuals in the angler harvest. This caused some concern in both sportfishing community as well as the biologists that the adult perch may be getting removed from the population before they had a chance to spawn. Therefore, WDNR has adopted a modification to the closed season.

Management Actions

All yellow perch assessments and harvest data from the Wisconsin waters of Lake Michigan show weak year-classes beginning with the 1990 year-class. However, the 1998 year-class was the strongest year-class in recent years and is supporting the fishery. The 1998 year-class comprised 92% of the sport caught yellow perch, and 94% of the spawning population in 2003. These observations are consistent with data collected by other agencies throughout the lake. Effective September 1996 commercial fishing was closed in the Wisconsin waters of Lake Michigan and daily sport bag limit was reduced to 5 fish. The sport fishery for Lake Michigan yellow perch is closed from May 1 to June 15. These rule changes are implemented to benefit the perch population by reducing impact on spawning stocks. Recently, sport fishery has been dominated by a single year-class of 1998, which grew faster and attained larger size. However, the harvest declined markedly from 2001 to 2003 indicating this year-class can only support the fishery for so long. Even the catches from 2004 winter graded mesh assessment are all time low. The conditions in the lake and weather pattern may have implications in the lower catches in the assessment gill net. But, one year-class can only hold so long. We haven't seen sizable recruitment to the fishery after 1998 year-class.

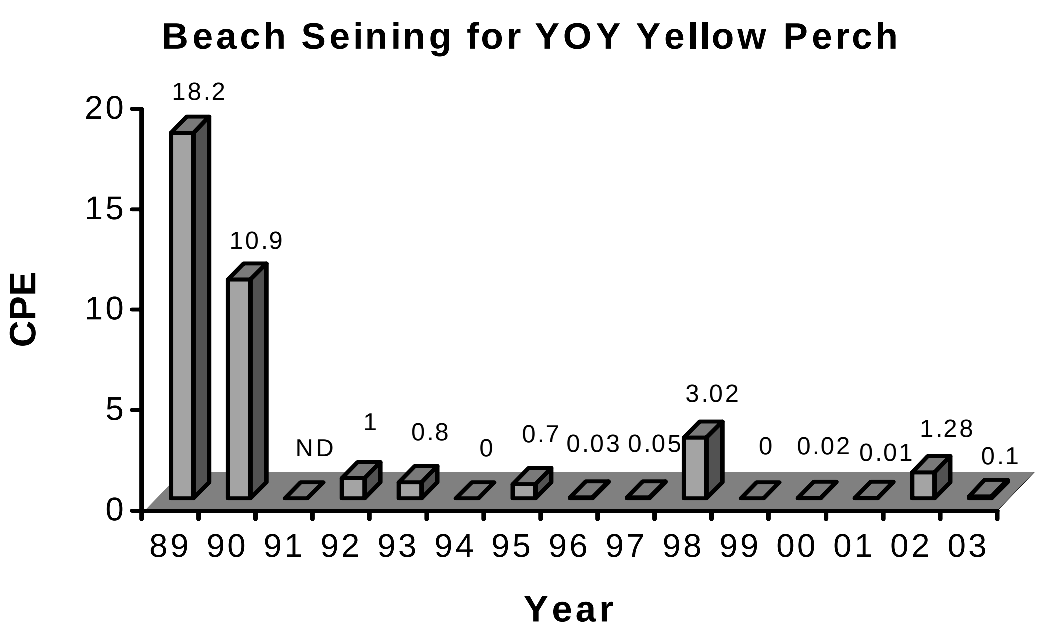

Figure 1. CPE (fish/100' seine haul) of YOY yellow perch in summer beach seining.

Table 1. Yellow perch spawning assessment in Milwaukee waters (Green Can Reef) of Lake Michigan - 1990-2003.

Year	Total	Males	Females	Sex-unknown	% Females	Total effort[1]
1990	2,212	1,922	290	1	13	19,200
1991	3,474	2,600	874	2	25	14,400
1992	7,798	5,242	2,556	1	33	14,400
1993	2,085	1,188	897	0	43	14,400
1994	401	330	71	0	18	9,600
1995	1,272	1,233	39	0	3	17,000[2]
1996	4,674	4,584	90	0	2	14,400
1997	14,474	14,417	46	11	0.32	5,000[3]
1998	4,514	4,283	231	0	5.1	24,600[4]
1999	5,867	5,635	232	0	4	9,200
2000	855	722	133	0	15.5	3,700
2001	1,431	993	438	0	31	5,400
2002	1,812	1,645	167	0	9.2	2,500
2003	1,609	1,583	26	0	1.6	1,700

[1] effort = length of gill net in feet
[2] includes 7,000 feet of standard 2 1/2 " mesh commercial gill net
[3] in addition to this 5,000' of commercial gill net, double-ended fyke nets were used
[4] in addition, 11 lifts of contracted commercial trap net and 4 lifts of fyke nets were used

Table 2. Catch per Effort (fish/1000ft./night), and the percent of each sex, of yellow perch caught in standardized assessment graded mesh gill net sets conducted in January each year, WDNR, Lake Michigan Work Unit.

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	626	724	159	49	60	0	0	0	0	0	42	323	1	0	2	3
3	1854	1037	865	276	98	25	0	0	4	2	57	65	243	4	0	1
4	1012	938	323	715	402	58	28	0	14	6	215	9	20	118	0	0
5	1563	394	327	281	757	218	65	0	11	29	93	27	2	4	33	1
6	1880	381	83	181	165	141	120	19	18	35	57	2	2	3	0	27
7	155	90	82	126	49	48	76	51	77	20	45	0	1	1	0	1
8	1	0	32	73	16	11	65	71	251	43	63	8	2	0	0	0
9	0	0	0	14	0	0	24	31	109	110	44	9	1	0	0	0
10	0	0	0	0	0	0	2	12	15	60	33	11	1	0	0	0
11	0	0	0	0	0	0	0	3	0	15	9	1	1	1	0	0
12	0	0	0	0	0	0	0	0	0	4	7	0	0	1	1	1
%Male	69	61	72	82	86	89	90	95	89	80	58	36	36	38	52	60
%Female	31	39	28	18	14	11	10	5	11	20	42	64	64	62	48	40

Note: Aging of yellow perch changed from scales to spines starting in 2000 to be consistent with Green Bay methodology.

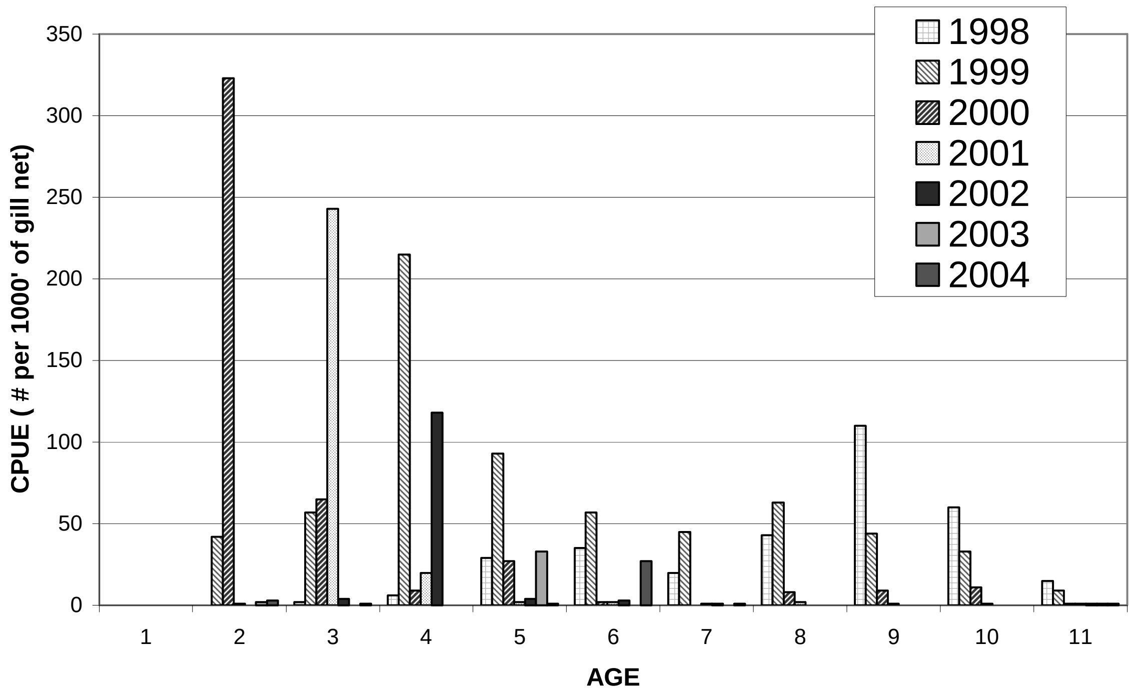

Figure 2. Comparison of catch-at-age for yellow perch in Wisconsin waters of Lake Michigan, 1998-2003.

Table 3. Reported commercial Lake Michigan yellow perch harvest (excluding Green Bay), in thousands of pounds, and sport harvest, estimated in thousands of fish, by calendar year.

Year	Commercial harvest (lb. x 1000)	Sport harvest (number x 1000)
1986	373	411
1987	550	639
1988	431	932
1989	267	719
1990	256	649
1991	326	887
1992	282	960
1993	267	546
1994	254	290
1995	128	247
1996	15[a]	95[b]
1997	Closed	31[b]
1998	Closed	38[b]
1999	Closed	34[b]
2000	Closed	75[b]
2001	Closed	134[b]
2002	Closed	98[b]
2003	Closed	89[b]

[a] commercial yellow perch fishery was closed starting September 1996
[b] sport bag limit was reduced to 5/day effective September 1996
(Note: Sport harvest data includes Moored boat catch since 1989)

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STATUS OF BURBOT IN WISCONSIN WATERS OF LAKE MICHIGAN

Introductions

One of the objectives of the Lake Michigan Lakewide Assessment Plan (Schneeberger et al.) is to annually determine relative abundance, mortality, age structure, fish health, and diet of several top predators including lake trout (Salvelinus namaycush), Chinook Salmon (*Oncorhynchus tshawytscha*), and burbot (*Lota lota*) at selected sites around Lake Michigan. Of the three sites Wisconsin DNR samples in spring for this assessment, burbot have been captured at two of the sites, the nearshore waters off Sturgeon Bay and Sheboygan. We examined the information collected on burbot captured from 2000 to 2002 to characterize the age structure, size at age, diet and general physical health for these two areas of Lake Michigan.

Methods

Burbot were captured in graded mesh gill nets (62-152mm) fished during April and May from 2000 to 2002 off Sturgeon Bay and Sheboygan. Biological data collected on burbot included total length (mm), sex, and sexual maturity. Whole fish were also examined externally and internally for signs of abnormalities or disease (necropsy). Otoliths were collected and aged from a sub-sample of fish. Burbot not aged with otoliths were aged using an age-length (20 mm intervals) key of otolith-aged fish, separated by area and sex. Because of the small sample sizes, we pooled fish from all three years by sex and area to characterize age structure in each location. Otolith-aged fish were combined for sex, location, and years to determine average total length (mm). In 2000 and 2001 stomachs were removed, frozen and analyzed for contents following the diet study guidelines of Elliott et al. (1996). Necropsy data was summarized to determine if any abnormalities were prevalent in burbot sampled at the two sites.

Results

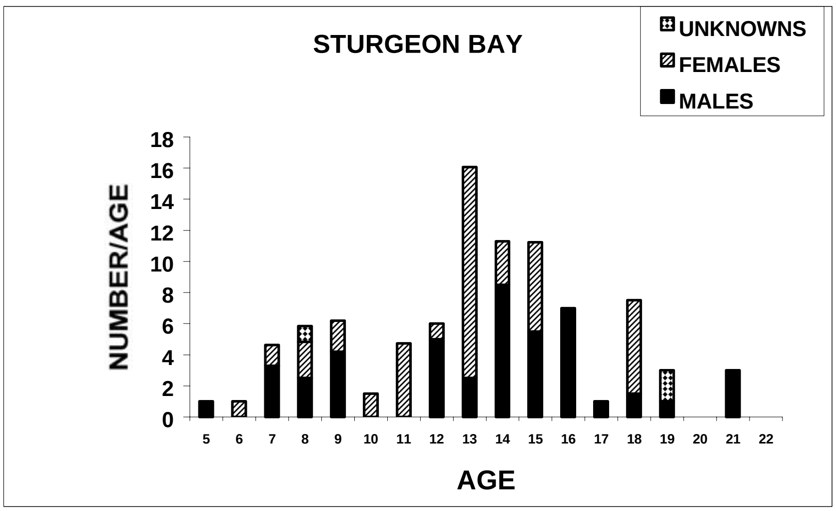
Burbot ages ranged from 5 to 21 (age 14 missing) for males and 6 to 18 (age 13 missing) for females off Sturgeon Bay (Figure 1). Males ranged from ages 6 to 22 off (ages 7-9, 15 –16, 18, 20-21missing) off Sheboygan and females ranged from ages 7 to 18.

Burbot were more than twice as abundant (CPE) off Sturgeon Bay in 2000 and 2001 and about equal in abundance in 2002 in assessment nets off Sturgeon Bay and Sheboygan (Figure 2).

Average length (mm) at age for both sites combined across sex and years for otolith-aged fish (ages 5 to 19) was lower for this time period (2000-2001) compared to 1986 to 1988 length-at-age data of Bruesewitz (1990); (Figure 3).

Diet composition in spring expressed as percent prey weight, varied across burbot size group, location, and year (Figure 4). The smallest size fish (200-399 mm) were caught only in 2001. Off Sturgeon Bay the diet was 72% alewife (*Alosa pseudoharengus)* and smelt (*Osmerus mordax),* while off Sheboygan it consisted of sticklebacks, threespine (*Gasterosteus aculeatus)* or ninespine (*Pungitius pungitius)*. The next largest size burbot (400-599 mm) caught off Sturgeon Bay in 2000 had a diet of 48% alewife and smelt and 52% sculpin (*Cottus* species) and sticklebacks, while in 2001 the diet was about 88% alewife and smelt. Off Sheboygan in 2000 the diet was 46% sculpin, 28% alewife, and 18% sticklebacks, while in 2001burbot ate about 84% sculpin and the rest alewife and smelt. The largest burbot caught in Wisconsin's assessment nets (600-799 mm) off Sturgeon Bay in 2000 ate a diet of about 80% smelt and alewife, while in 2001 the diet was about 46% alewife, 17% bloater chub (*Coregonus hoyi),* 16% whitefish (*Coregonus clupeaformis),* and 15% smelt. Off Sheboygan in 2000 burbot diet consisted of 48% smelt and 31% sculpin, and in 2001 the diet was 86% alewife and the rest sculpin.

At both Sturgeon Bay and Sheboygan more than half of the burbot netted had eye cataracts (Figure 5). Burbot with cataracts were collected and sent to WDNR fish health (Sue Marcquenski) several years ago. She attributed the cause of the cataracts to a parasite, *Diplostomum spathaceum,* which is know to have the potential to infect eyes in a large number of fish species.



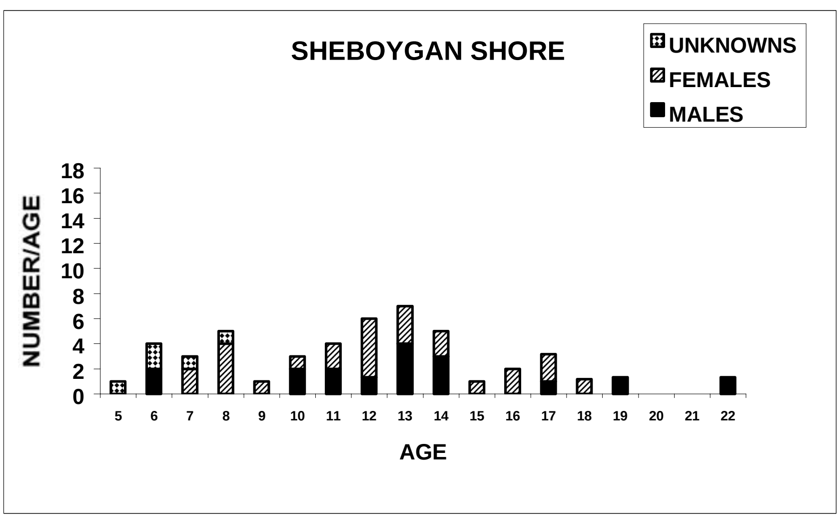


Figure 1. Number by age and sex for burbot collected by WDNR spring assessment netting off Sturgeon Bay and Sheboygan for 2000 to 2002 combined. A sub-sample of burbot were aged by otolith and the remaining fish were aged by age-length key (20mm).

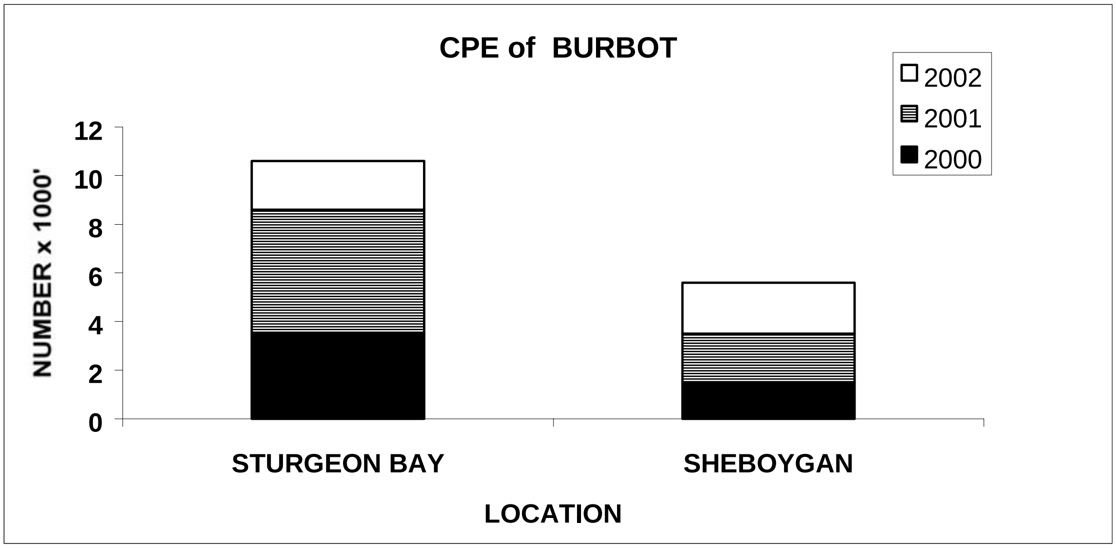


Figure 2. Total catch-per-unit effort (number per 1000' gill net) for burbot captured in spring Lakewide Assessment netting conducted by WDNR off Sturgeon Bay and Sheboygan in 2000 to 2002.

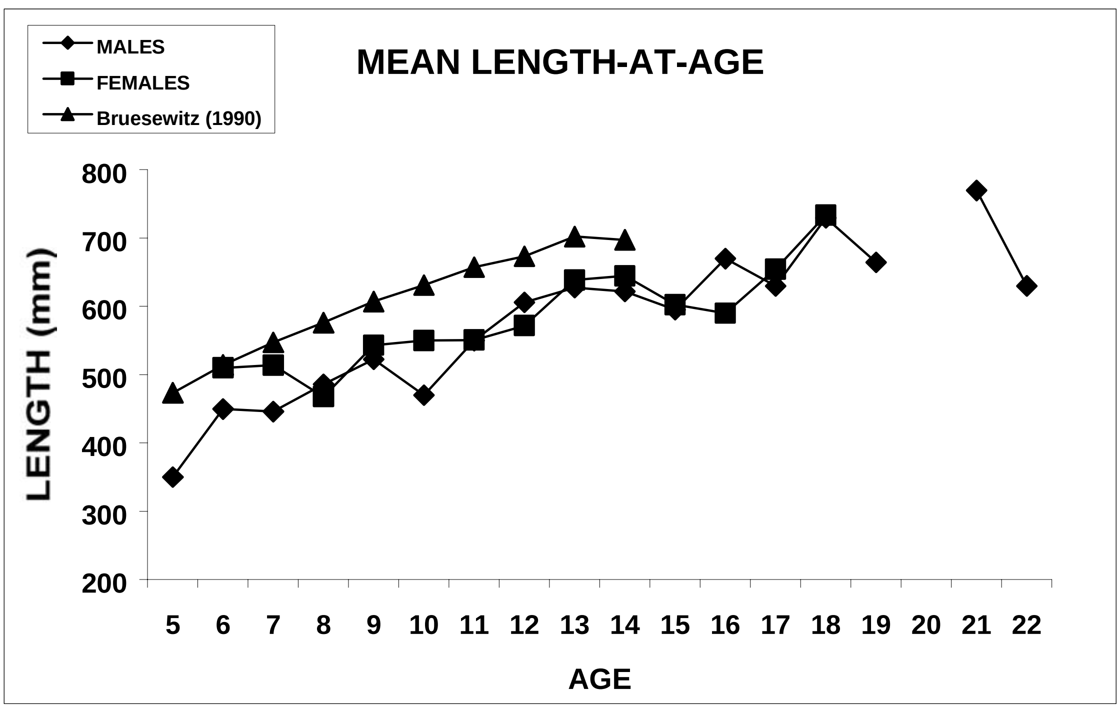


Figure 3. Mean length-at-age (mm) for otolith aged burbot by sex for Sturgeon Bay and Sheboygan combined across all three years and compared to mean length of burbot collected in 1986 to 1988 in Lake Michigan as reported by Bruesewitz (1990).

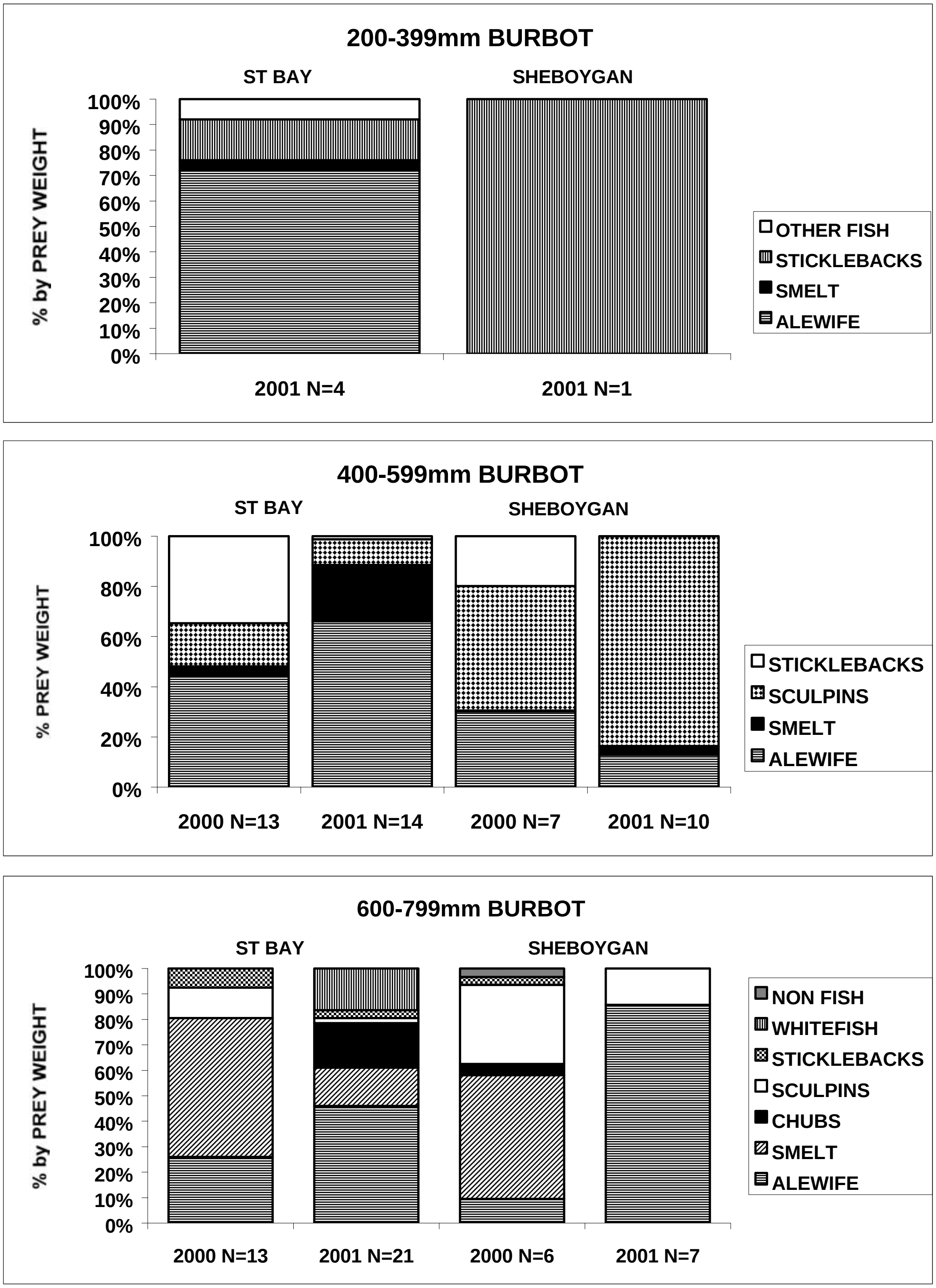


Figure 4. Percent prey by weight for burbot caught in WDNR spring assessments from 2000 and 2001 off Sturgeon Bay and Sheboygan. Burbot are grouped according to size group as suggested by Elliott et al. (1996).

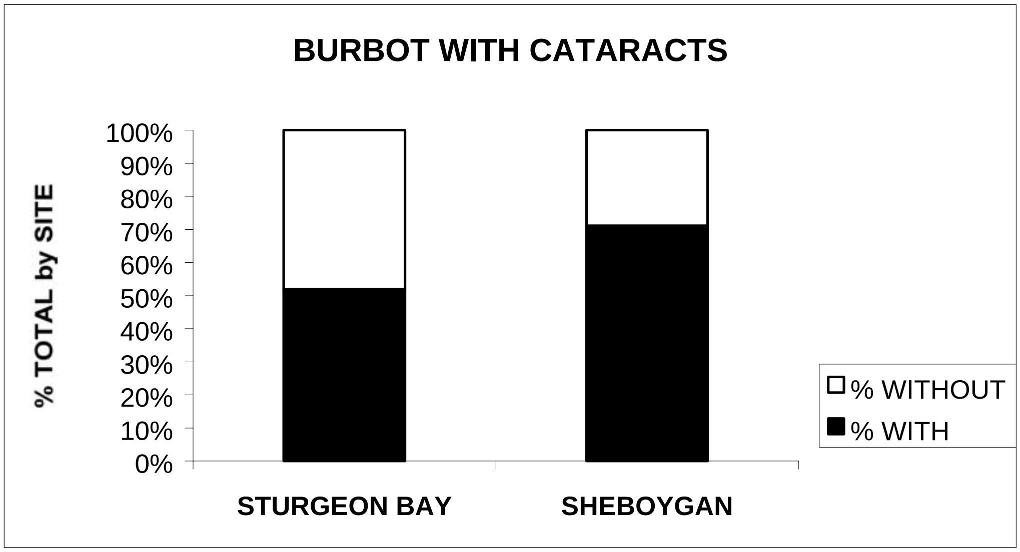


Figure 5. Percent burbot with cataracts of total burbot captured from 200 to 2002 in WDNR spring assessment netting off Sturgeon Bay and Sheboygan.

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WALLEYE RESTORATION IN THE MILWAUKEE RIVER

Background

The lower Milwaukee River has gone through some major changes in recent years, especially since the North Avenue Dam was breached in 1990 followed by a complete removal in 1997. Recently, the Wisconsin Department of Natural Resources (WDNR) has added some fish habitat enhancement structures in the channel and in the previously impounded area. These enhancements include the placement of 600 tons of limestone riprap and 200 tons of fieldstone boulders as in-stream habitat and the use of 25 willow trees as bank cover. While these changes are certainly benefiting anadromous trout and salmon, there appears to be an increase in the diversity of native fish species. The walleye (*Sander vitreus*), one of the native species of the Lower Milwaukee River and the harbor, has almost disappeared due to poor habitat quality. Until the early 1990s the nearshore anglers were dependent on the Lake Michigan yellow perch (*Perca flavescens*) as the main source of sport fishing opportunity for native fish in the area. However, the dramatic decline of yellow perch in the 1990s left very little opportunity for the local nearshore angling community. A combination of circumstances caused by the removal of the North Avenue Dam and the dramatic decline in the nearshore yellow perch fishery produced further impetus to rehabilitate walleye in the Lower Milwaukee River and harbor.

The long-term goal of the project is to develop a self-sustaining walleye population in the lower Milwaukee River and harbor. In 1998, a detailed Milwaukee River Walleye Restoration Plan (WDNR 1998) was developed with the help of public input. The project, as it progressed, encompassed several objectives to accomplish this goal without negatively impacting the existing fishery.

The study area encompassed the Milwaukee harbor and the waters of three rivers - the Milwaukee, the Menomonee and the Kinnickinnic - from their confluence up to the first Dam. The outer harbor encompasses about 607 ha which includes the area inside the South Shore breakwalls (Figure 1). These rivers flow through highly urbanized areas of Milwaukee before draining into Lake Michigan. There is limited amount of spawning or nursery habitat in the upstream waters except some wetland habitat where the Lincoln Creek drains into the Milwaukee River (Will Wawrzyn, WDNR, Personal communication). The annual water temperature varies from ice over in the winter to as high as 32 ^{0}C in the summer.

Recent stocking effort

In 1995, with initial funding support of $10,000 from the Lakeshore Fisherman Sports Club, WDNR developed a plan to raise and stock extended growth (150-180mm, total length) walleye fingerlings as part of the walleye population restoration effort (Table 1). Since then, the project has evolved to include many other aspects to understand and evaluate the developing walleye population in the area, and its impact on other species, as well as angler response. The walleye fingerlings were stocked each year in October at a predetermined location just downstream of the former North Avenue Dam (Figure 1). This location is a transition area between the riverine condition and lacustrine condition. The water is deep enough that it will provide safer winter conditions for newly stocked fingerlings to survive. Although our goal was, per the 1998 walleye plan, to stock 10,000 extended growth fingerlings consistently every year through 2004, we were not able to achieve that goal in some years due to various circumstances (Table 1).

Monitoring of predatory impact on stocked salmonids

Predatory impact of the stocked walleye on stocked salmonid smolts was one of the main concerns that the local trout and salmon sport fishermen expressed initially. The Milwaukee allotment of 144,000 Chinook salmon smolts for Lake Michigan were stocked at the same location in May where the extended growth walleye fingerlings were intended to be stocked in the following October. In 1996 and 1997 we followed a study designed to examine the worst case scenario of predatory impact. Both years we stocked extended growth walleye fingerlings at the same location as that of Chinook salmon smolts. Predator stomach samples were collected at three time periods following stocking of Chinook salmon smolts in May 1996 and 1997. Intense sampling was conducted using a pulsed DC boat electroshocker at night to capture at least 100 walleye with full stomachs at each time period. The first sampling was carried out on the night following stocking of Chinook salmon smolts. The second and third samplings were conducted one week after stocking and three weeks after stocking. The stomach contents were expelled from the stomach by using a non-lethal stomach pump (SOLO Pressure Sprayer, 1 gallon with ¼ inch diameter tube). The fish was safely released after collecting biological data. The stomach contents were stored on ice in a whirl pack bag and analyzed the following day at the laboratory.

In 1996 and 1997, although the initial two rounds of sampling showed walleye with Chinook smolts in the diet (Figure 2), by the third week other food items such as non-salmonid fish and invertebrates dominated the stomach content (Coffaro et al. 1996). This may suggest that Chinook salmon smolts disperse in about 2-3 weeks and thus were not available for predation. Based on the information gained through this study, WDNR changed the location of stocking Chinook salmon smolts from the former North Avenue Dam to McKinley Marina in 1998. Ever since the stocking location was changed, we have not encountered any predatory impact on the Chinook salmon smolts immediately after stocking (Hirethota 1999).

Marking evaluation

An additional component of the study was the evaluation of Visible Implant Elastomer (VIE) marking technique. Elastomer is a colored, viscous latex fluid injected into tissue beneath the skin. Northwest Marine Technology, Inc. of Washington State developed this technology. Walleye stocked from 1995 to 2001 were given a specific mark (fin clip or VIE mark) to identify their year-class (Table 1). As part of the marking evaluation, one half of the fish stocked were given a fin clip and the other half were marked with a colored VIE injected under the jaw. Since 1995 there have been a total of 20,314 stocked walleye marked with VIE using a different color each year that would readily separate the year-classes. This allowed us to evaluate the survival and growth rates of these marked walleye and detect differences between the two marking techniques. We found no significant difference in growth rates between the differentially marked fish. We also found that tag detection in recaptured fish over the long term fell to fewer than 79% for fish originally VIE marked. A cost analysis showed that costs associated with VIE marking were ten times higher than finclipping. A single fin clip appears to be the more desirable technique for marking walleye.

Spawning migration and population estimates

We conducted spring spawning surveys to examine and document any natural reproduction. Beginning in spring 1998 we started seeing a few mature male and female walleye upstream of the former North Avenue Dam. Based on the mark we identified these mature fish as being from the 1995 and 1996 year-classes. Of the 154 walleye examined in 1998, there were two ripe males and one green female and one spent female. In the 2000 assessment, we found 25 males and 20 females (out of 103 total). The 1996 year-class appeared to have survived better than other year-classes and dominated the catch until year 2000. By this time they have had 3 summers of good growth, averaging 498 mm total length. These fish contributed to the greater number of mature walleye both male and female, including 7 spent females. Although there were very few mature walleye in the survey in each year, the fact that there were stray occurrences of spent females lead us to believe natural reproduction may be occurring in the river.

We used the mark-recapture method ($N = M * C/R$; where N is estimated number, M is number of marked walleye, C is the total number of captured walleye in the recapture run and R is the number of marked walleye captured) in May 1996 to estimate population size (Ricker 1975). Based on the mark-recapture method the estimated walleye population at that time was 795 (Table 2). These walleye were not adults, although the population estimation coincided with the spawning assessment in the subsequent years. We repeated the population estimate effort in 1998. Although our population estimate effort included all walleye, there were some mature fish in 1998. In order to increase the number of marked fish and recapture rates we employed the Schnabel multiple capture method. Population estimates were calculated for 2002 and 2003, which resulted in 428 and 875, respectively (Table 2). The low population estimates could be due to a combination of factors controlling survival, dispersal, and removal from the system.

Size-at-age

The stocked walleye seem to be surviving and growing well in this environment. Table 3 indicates annual growth rates of walleye stocked in the Milwaukee River. Growth rates from year-class to year-class appear to be similar. They reached an average size of 425 mm in three years. There is sufficient forage available in the form of alewife, gizzard shad, shiners and stickleback. Also, from the radio telemetry data, it seems these walleye follow a temperature regime and take refuge in the warmer Menomonee River canals during the winter. The growth rate of these walleye appears to be greater than average for walleye in Wisconsin (Nancy Nate, WDNR, personal communication).

Seasonal movement pattern using radio telemetry

In order to examine the seasonal movement pattern of adult walleye on a large spatial scale, in April 2000 implanted 15 walleye and 5 smallmouth bass with radio transmitters. We continued this effort in fall 2000 and all of 2001. Each year we divided the total number of walleyes implanted into two batches. One batch of walleye implanted with radio transmitters was released in the Milwaukee River below the former North Avenue Dam and the other batch was released at the Summerfest lagoon in the Milwaukee Harbor. These locations are geographically separated by about 10 km and represent different habitat types.

The radio telemetry data have provided valuable information on the movement pattern of walleye in the Milwaukee River and Harbor for the first time. The fish that were released in the river stayed upriver during the spring and early summer. As the summer progressed these fish moved downstream and were subsequently found in the harbor, especially in the lagoon east of the Summerfest grounds. This was probably due to the increased water temperature in the river causing the fish to seek refuge in the deeper, cooler harbor water. By coincidence, this movement pattern helps keep adult walleye away from Chinook salmon smolts when they are stocked in the harbor in late spring. The preliminary data on the seasonal movement also indicate that the adult walleye follow a temperature regime and take refuge in the warmer Menomonee River canals during late fall and in winter. The radio telemetry study showed a clear seasonal and spatial movement pattern.

Management implications

With the complete removal of the North Avenue Dam in 1997, the Milwaukee River has opened up an additional 9.6 km of river for fishing. Angler response to the renewed opportunity to fish walleye in the area has been positive and very encouraging. Creel survey data indicated a sharp increase in the directed angling effort for walleyes in 1997 and 1998, the second and third years of the current reintroduction effort. At this point, the goal of the WDNR is to continue stocking 10,000 extended growth walleye fingerlings through 2004. Extended growth walleye fingerlings appear to have better survival as evidenced by some of the lakes in New York State (Brooking et al. 2002). The results from our continued evaluation of predatory impact since 1998 indicated no direct impact on the smolts immediately after releasing due to predation. Shore anglers frequently report catching walleye on the Milwaukee River all the way up to Kletzsch Park, as well as on Menomonee River and its canals. Based on the data on growth, survival, movement patterns, impact on other species and angler response, we believe that the project has lived up to its positive expectations.

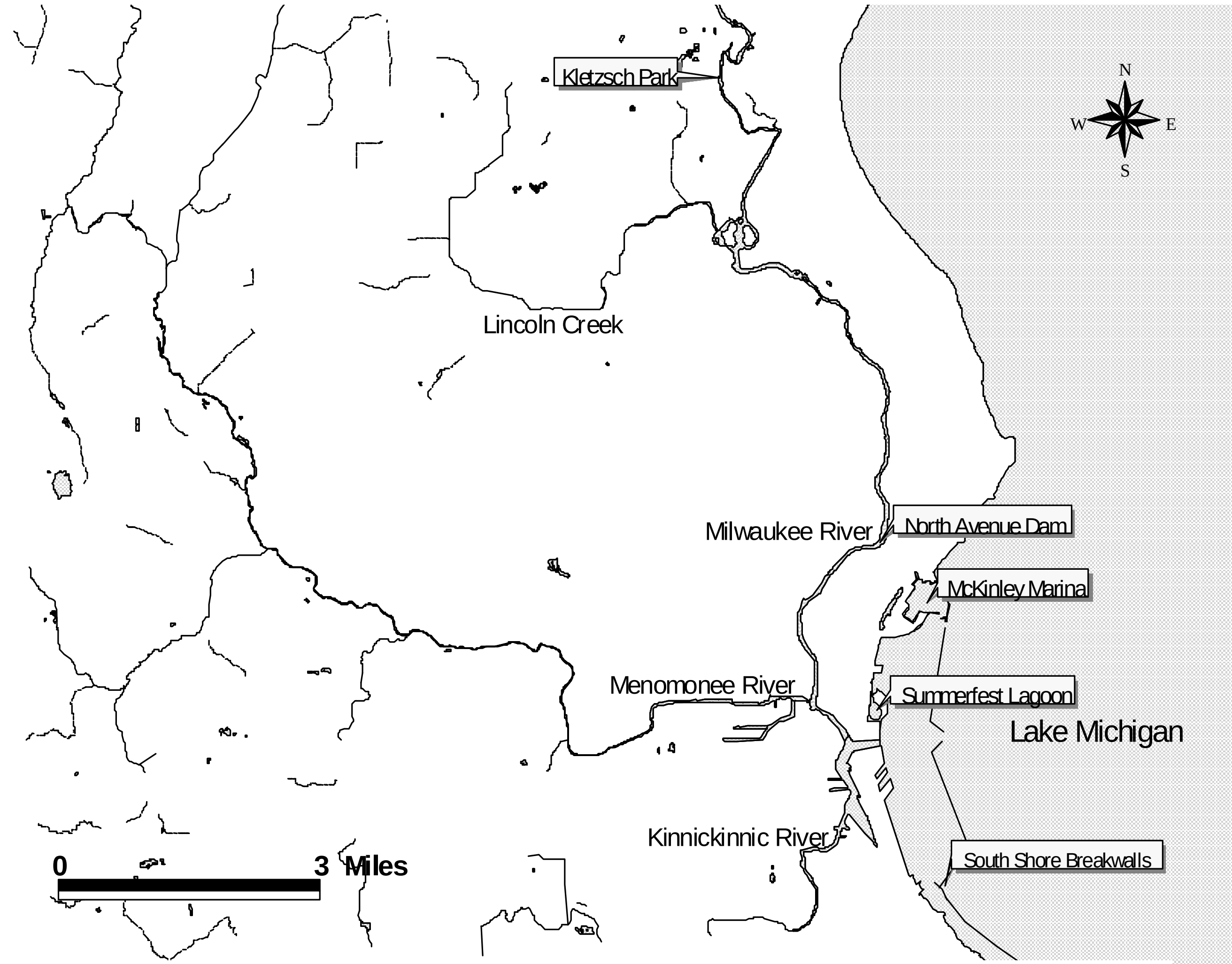

Figure 1. Study area, including Milwaukee, Menomonee and Kinnickinnic Rivers, and the Milwaukee Harbor.

Table 1. Number of walleye fingerlings stocked in the lower Milwaukee River below the former North Avenue Dam.

Year	# stocked	Age at stocking	Source	Strain	Mark type
1995	7,626	Extended growth fingerlings[1]	WDNR Spooner Hatchery	Unknown	RP/REL
1996	9,972	Extended growth fingerlings[1]	WDNR Spooner Hatchery	Unknown	LP/GEL
1997	None				
1998	3,155	Extended growth fingerlings[1]	Private Hatchery	Lake Michigan	RV/BEL
1999	7,700	Fingerlings[2]	WDNR Kettle Moraine Springs Hatchery	Lake Michigan	None
2000	9,880	Extended growth fingerlings[1]	WDNR Spooner Hatchery	Lake Michigan	LV/OEL
2001	10,000	Extended growth fingerlings[1]	WDNR Spooner Hatchery	Lake Michigan	RP/PEL
2002	5,600	Extended growth fingerlings[1]	WDNR Spooner Hatchery	Lake Michigan	LP
2003	11,000	Extended growth fingerlings[1]	WDNR Spooner Hatchery	Lake Michigan	RV

[1] Extended growth fingerlings (average size 150-180mm total length)
[2] Fingerlings (average size 64mm total length)

Legend:

RP = right pectoral fin clip
LP = left pectoral fin clip
RV = right ventral fin clip
LV = left ventral fin clip

REL = red elastomer
GEL = green elastomer
BEL = blue elastomer
OEL = orange elastomer
PEL = purple elastomer

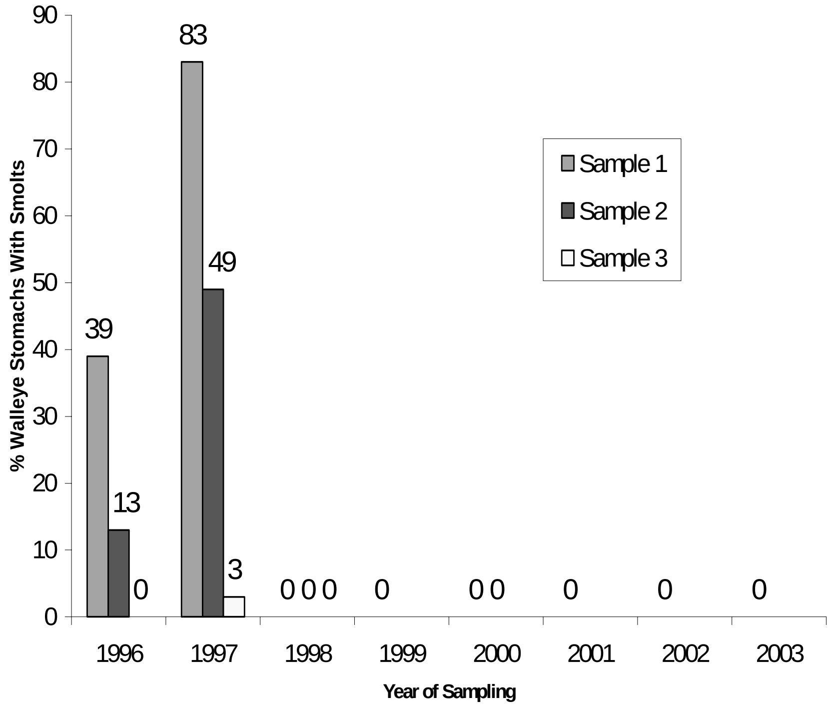

Figure 2. Predation impact by stocked walleye on stocked Chinook salmon smolts expressed as percentage of walleye stomachs containing smolts in the Milwaukee River. (Stocking location for Chinook salmon smolts was changed to McKinley Marina in 1998).

Table 2. Population estimate of walleye (all sizes) in the lower Milwaukee River.

Assessment year	**Estimated walleye**	**95% confidence interval**	**Method (Ricker 1975)**	**Comment**
1996	795	115≤ N ≤ 1475	Chapman Modification of a Petersen method	No adult fish
1998	745	405≤ N ≤ 1586	Schnabel multiple capture	All walleye
2002	428	129 ≤ N ≤ 727	Chapman Modification of a Petersen method	All walleye
2003	875	401≤ N ≤ 2388	Schnabel multiple capture	All walleye

Table 3. Size-at-stocking and size-at-capture of walleye stocked in the lower Milwaukee River and Harbor.

Year of Stocking	Average size at stocking (mm)	Average size (mm) at capture							
		1996	1997	1998	1999	2000	2001	2002	2003
1995	161	162 (154)	305 (8)	441 (29)	465 (1)	535 (7)	567 (1)	-	-
1996	187		206 (151)	321 (101)	435 (25)	498 (63)	571 (10)	553 (5)	631 (1)
1998	169				197 (4)	377 (13)	445 (10)	513 (7)	511 (3)
2000	193						368 (5)	381 (10)	466 (5)
2001	188							193 (75)	321 (25)
2002	195								202 (78)

Note: Number in parenthesis is the sample size

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CHINOOK STOCKING TECHNIQUE STUDY

The Wisconsin Department of Natural Resources (WDNR) has been stocking chinook salmon as part of the Lake Michigan fisheries management program since 1969. Over the last two decades, the WDNR has completed several coded wire tag (CWT) studies that have helped us improve the efficiency of chinook fingerling rearing and stocking. The studies have included evaluations of hatching, rearing, sterilization, and stocking techniques. One of the previous studies compared recovery rates of chinook fingerlings stocked by three different techniques. This study demonstrated that chinook fingerlings stocked in a river or in a rearing pond with subsequent release to a river are recovered at higher rates than chinook fingerlings stocked directly into Lake Michigan. Harbor stocked fingerlings became an unplanned, non-replicated part of this study when fisheries technicians decided, that because of a pounding Lake Michigan surf on the day of stocking, to put one of the chinook lots destined for the lake, in the harbor. This group of harbor stocked fingerlings was subsequently recovered at a higher rate than fingerlings stocked by any of the other techniques.

Researchers on the Pacific Coast demonstrated that in spring and early summer, in the Columbia River, Washington, juvenile salmonids (mostly sub-yearling chinook salmon) were 59 percent of smallmouth bass diets and 28.8 percent of northern squawfish diets. If in fact the rivers in which chinook fingerlings are stocked become a predator lined gauntlet that they must run, stocking further upstream may increase the risk of predator encounter. The stocking of chinook fingerlings in a river has been shown to be more effective than stocking directly into the lake, however, stocking of chinook too far upstream may be counterproductive. This study will attempt to further refine chinook fingerling stocking techniques by stocking four lots of CWT chinook fingerlings in the Kewaunee River at various distances upstream from Lake Michigan.

During the spring of 1998 and 1999, experimental lots of chinook salmon fingerlings, marked with coded wire tags (CWT), were stocked in the Kewaunee River at various distances upstream from Lake Michigan (harbor, four miles, nine miles, and 15 miles) to determine if stocking location had an impact on mature salmon recovery rates.

Over 5,000 mature CWT chinook salmon from this study were collected at Besadny Anadromous Fisheries Facility (BAFF), fall 1999 through fall 2002 (Table 1). Few additional recoveries of chinook from this study are anticipated.

Chinook fingerlings from the 1998 year-class of the stocking technique study had a cumulative recovery rate of 0.86 percent and the 1999 year-class had a cumulative recovery rate of 4.08 percent. The difference between the recovery rate for the 1998 and 1999 year-classes returning to BAFF is not believed to be related to the stocking location study as similar recovery rates for the 1998 and 1999 year-classes were observed for CWT chinook returning to the WDNR Strawberry Creek Weir (SCW).

In both the 1998 and 1999 year-classes, chinook salmon fingerlings stocked directly into the Kewaunee River at the intermediate distances were recovered at BAFF at higher rates than those stocked in the harbor or those stocked at the stocking site furthest upstream (Table 1, Figure 1). Cumulative recovery rate of the 1998 year-class at BAFF through age 4+ Ranged from 1.32 percent for the fingerlings stocked at Clyde's Hill Road, 0.92 percent for the lot stocked at BAFF, 0.73

percent for the fingerlings released at Highway 54, to 0.46 percent for the harbor stocked individuals. Cumulative recovery rate for the 1999 year-class ranged from 4.81 percent for the fingerlings stocked at Clyde's Hill Road and those stocked at BAFF, 4.12 percent for the study lot stocked in the harbor, to 2.58 percent for the fingerlings stocked furthest upstream at Highway 54.

Table 1. Rate of return for chinook salmon stocking technique study, at age, to the Besadny Anadromous Fisheries Facility. Rate of return expressed as a percent of the number of chinook stocked in the Kewaunee River that were actually recovered at the Besadny Anadromous Fisheries Facility through the fall of 2002. The percent return is followed by the actual number of fish recovered in parentheses.

Year Class	STOCKING LOCATION	AGE AT RETURN				CUMULATIVE Rate of Return
		1+	2+	3+	4+	
1998	HARBOR	0.14 (35)	0.13 (34)	0.19 (48)		0.46 (117)
	BAFF	0.37 (94)	0.22 (57)	0.33 (85)		0.92 (236)
	CLYDE'S	0.41 (105)	0.31 (78)	0.60 (153)	<0.00 (1)	1.32 (337)
	HWY 54	0.22 (57)	0.22 (56)	0.29 (75)		0.73 (188)
1999	HARBOR	0.32 (70)	1.55 (341)	2.26 (498)		4.12 (909)
	BAFF	0.53 (129)	1.88 (460)	2.40 (587)		4.81 (1,176)
	CLYDE'S	0.53 (129)	1.86 (457)	2.42 (594)		4.81 (1,180)
	HWY 54	0.30 (72)	1.05 (255)	1.24 (301)		2.58 (628)

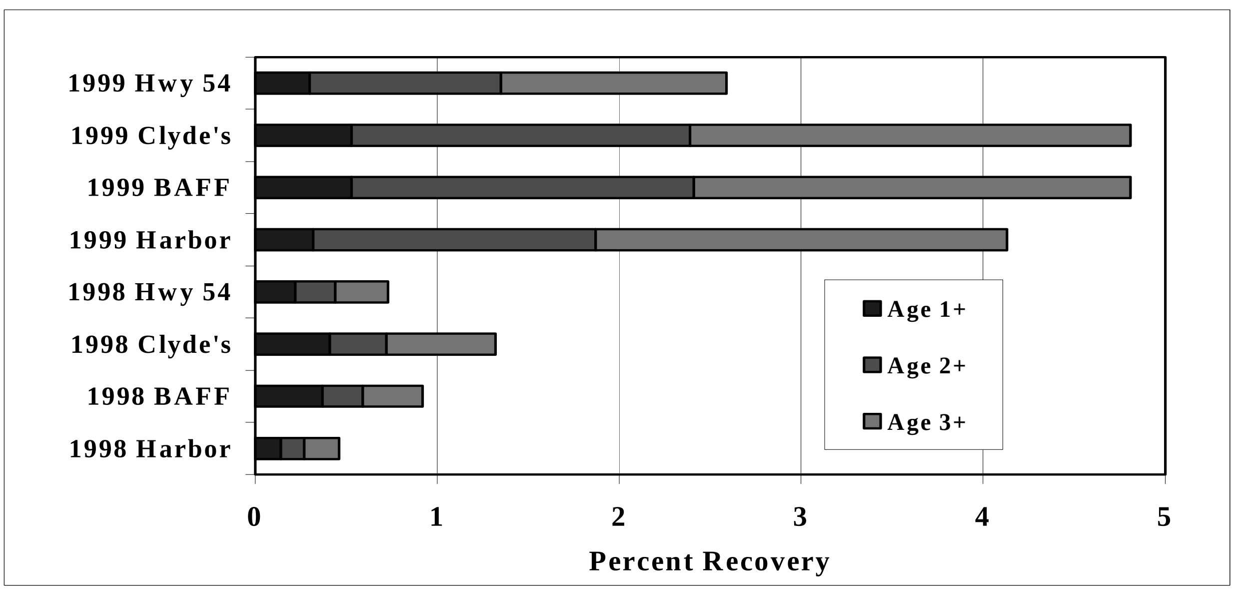

Figure 1. Percent recovery of CWT chinook salmon, from the 1998 and 1999 year-classes, at age, at the Besadny Anadromous Fisheries Facility, from the stocking technique study, through fall 2002.

These recovery rates represent a minimum known recovery rate at BAFF. Each fall during the recovery period, some of the adipose clipped chinook encountered at BAFF were not retained for CWT extraction because they were dead when processed and had started to decompose. Others were collected but the tag was lost during extraction, or it was determined that the fish was no longer carrying a CWT (tag loss before capture). Additionally, a portion of the chinook heads collected from BAFF during fall 2002 (~250) did not freeze properly during storage and had to be disposed of because of the advanced stage of decomposition. Comparison of the recovery rates between study groups within a year-class should still be valid as it is unlikely that the study group to which an individual fish belonged influenced the likelihood of having a tag successfully extracted.

Miscellaneous Recoveries

In addition to the recovery of chinook from this study at BAFF, twelve chinook from the stocking location study were also recovered as strays at the WDNR SCW, and 188 study chinook were caught and turned in by anglers participating in the Lake Michigan sport fishery (Table 2). Compared to the 4,771 study chinook recovered at BAFF, the twelve study chinook recovered as strays at SCW is a relatively small sample size. However, ten of the twelve strays (83.3 percent) that showed up at SCW were from the harbor stocking site. This would seem to indicate that chinook stocked in the harbor are not as strongly imprinted, and are more likely to stray.

Table 2. Number and cumulative rate of return for chinook salmon stocking technique study, from miscellaneous sources of CWT recovery. Rate of return expressed as a percent of the number of chinook stocked in the Kewaunee River that were recovered. The actual number of fish recovered is followed by the percent return in parentheses.

YEAR CLASS	STOCKING LOCATION	MISCELLANEOUS SOURCES OF CWT RECOVERY			CUMULATIVE NUMBER AND (RATE OF RETURN) MISCELLANEOUS SOURCES
		WISCONSIN SPORT ANGLERS	MICHIGAN SPORT ANGLERS	STRAYS TO STRAWBERRY CREEK WEIR	
1998	HARBOR	10 (0.04)	4 (0.02)	0	14 (0.06)
	BAFF	5 (0.02)	2 (0.01)	0	7 (0.03)
	CLYDE'S	5 (0.02)	5 (0.02)	0	10 (0.04)
	HWY 54	1 (<0.01)	9 (0.04)	0	10 (0.04)
1999	HARBOR	30 (0.14)	22 (0.10)	10	62 (0.28)
	BAFF	9 (0.04)	28 (0.11)	2	39 (0.16)
	CLYDE'S	14 (0.06)	22 (0.09)	0	36 (0.15)
	HWY 54	9 (0.04)	13 (0.05)	0	22 (0.09)

Strawberry Creek is logically not the only location to which chinook salmon from this study on the Kewaunee River would stray, but it is the only other salmon collection facility in the vicinity at which chinook were captured and checked for identifying fin clips. If in fact the percentage of chinook straying to SCW is representative of all the chinook straying from the Kewaunee River, harbor stocking would seem to be a more viable stocking alternative than indicated by returns to BAFF alone.

Study fish caught by sport anglers, affords another analysis of the study results (Table 2). Of the

188 study fish caught and turned in by anglers, 66 (35.1 percent) were harbor stocked, 44 (23.4 percent) were stocked at BAFF, 46 (24.5 percent) were stocked at Clyde's Hill Road, and 32 (17.0 percent) were stocked at US Highway 54. A sample size of 188 does not have the same robustness as a sample size of 4,771. However, if in fact, the 188 fish are representative of the chinook salmon caught by anglers, harbor stocking of chinook would seem to be a more viable alternative than indicated by the BAFF recoveries.

In the previous study of chinook stocking locations conducted by the WDNR (Peeters and Toneys, 1995), the single lot of chinook stocked in the East Twin Harbor (unplanned and unreplicated) was recovered at a higher rate than all other stocking techniques.

Size at Age

Stocking location did not impact the length and weight at age of chinook returning to and recovered at BAFF. Length and weight at age for male and female chinook, within a year-class, from both the 1998 and 1999 year-classes did not vary significantly by stocking location. As an example, at age 1+, the average length for all four study lots of male chinook in the stocking location study, from the 1998 year-class, were within 17.1 mm. At age 2+ and age 3+ the average lengths at age, between the four study groups, were within 16.8 mm and 3.2 mm respectively. Similar small differences between the four stocking locations were noted for both sexes of both year-classes.

There was a difference in size at age between the 1998 and 1999 year-classes of chinook that were part of the stocking location study. Both sexes of the 1998 year-class were larger in length and weight at all ages than individuals from the 1999 year-class (Figure 2). CWT chinook from SCW studies from the 1998 and 1999 year-classes exhibited an almost identical pattern of growth (Figure 2). The implication would be that the size at age of chinook salmon is determined by conditions in Lake Michigan proper and not by stocking location.

The primary objectives of the WDNR for stocking chinook fingerlings in Lake Michigan are to support and maintain a put, grow, and catch salmon sport fishery and to help control alewife populations. Chinook are not reproducing in Wisconsin tributaries to Lake Michigan, and to sustain the chinook population, it is necessary for WDNR to keep stocking fingerlings on an annual basis. Stocking with subsequent imprinting in rivers with salmon collection weirs is important to assure a reliable and adequate supply of mature chinook for gamete collection. The WDNR operates three salmon collection facilities on Lake Michigan. The primary chinook egg collection facility is at Strawberry Creek in Door County. In normal years, WDNR collects all of the chinook gametes needed for stocking back into Lake Michigan at this facility. The other WDNR salmon collection facilities are considered backup facilities for chinook gamete collection. This study demonstrates that stocking chinook fingerlings in the river 4-9 miles upstream from the mouth enhanced chinook recovery rates at BAFF. Stocking chinook fingerlings in the harbor or at greater distances upstream (15 miles) resulted in lower recoveries at BAFF. However, this study and the study conducted by the WDNR in the late 1980's (Peeters and Toneys 1995) demonstrated that chinook fingerlings stocked in the harbor of large rivers experienced higher angler recovery rates than fingerlings stocked further upstream.

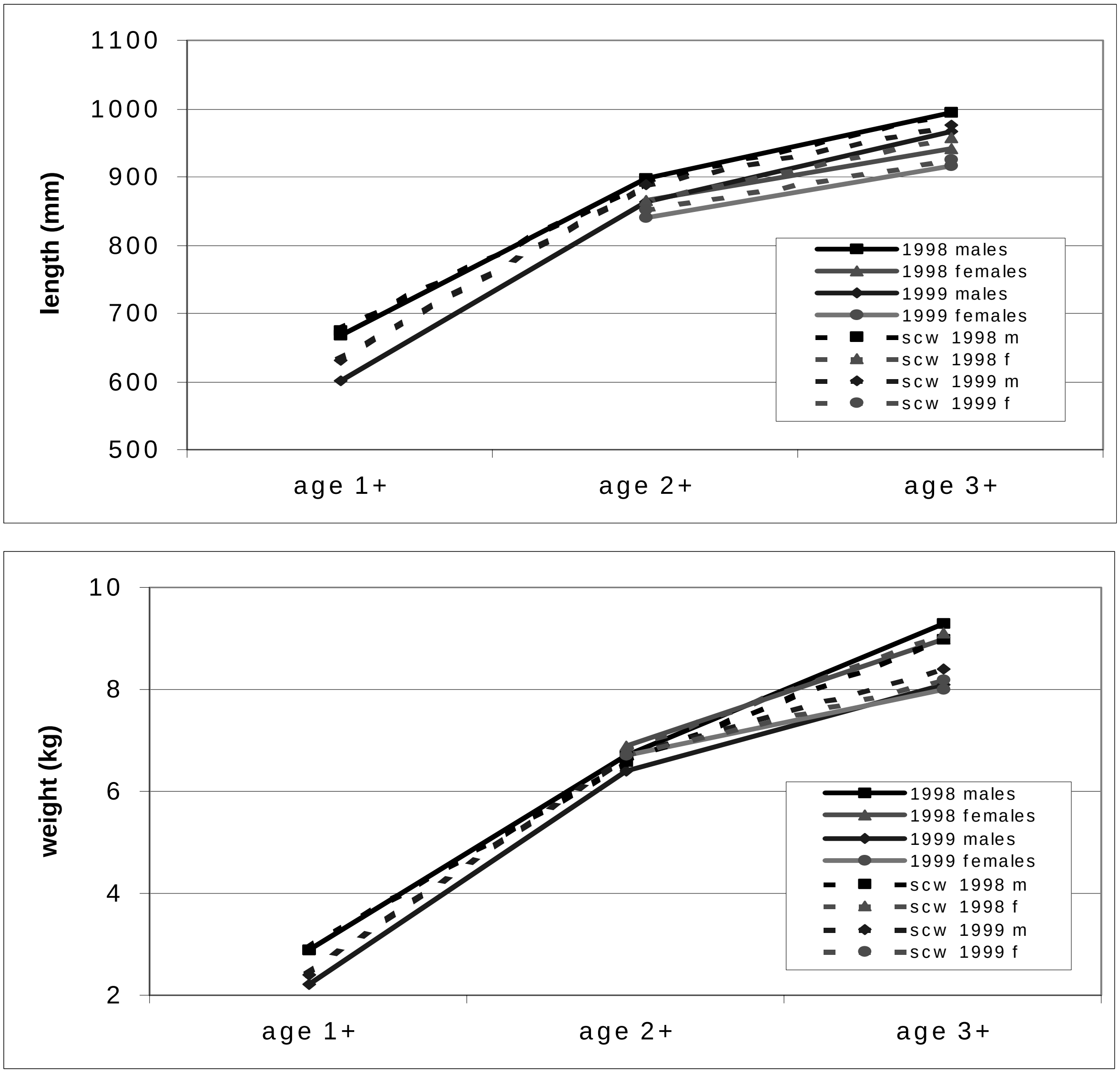

Figure 2. Length and weight at age for known age CWT chinook from the 1998 and 1999 year-classes. Fish graphed with solid lines are from the Kewaunee River stocking technique study and fish graphed with dashed lines are from SCW studies.

Management Recommendations

On rivers where it is important to encourage a mature chinook spawning run, for the purposes of gamete collection, or to encourage an in river fall sport fishery, chinook fingerlings should be stocked directly into the river. Further, it would seem appropriate based on this present study, to stock chinook fingerlings upstream from the harbor areas but within ten miles of the mouth of the river to ensure adequate imprinting, but not excessive in river mortality.

In situations where no gamete collection is planned, chinook contribution to the sport fishery and alewife control are the primary objectives. Imprinting and stream fidelity are less important. In these stocking situations, based on past and present studies, river stocking of chinook fingerlings is strongly recommended whenever possible. However, in this situation chinook fingerlings should be stocked lower in the river, including harbor stocking where appropriate. As a result of the lower stream fidelity at maturity, this technique is also likely to encourage straying to other streams when these fish mature and commence their spawning run.

Finally, the stocking of chinook fingerlings directly into Lake Michigan or Green Bay should be discouraged as much as possible. The past stocking technique study by WDNR demonstrated that direct lake stocking of chinook fingerlings was the least effective technique of chinook fingerling stocking.

This study was designed to use the BAFF as the primary CWT recovery technique as mature chinook salmon completed their spawning run. Although there was no consistent attempt to recover study fish lake wide, CWT chinook from this study were recovered from anglers throughout Lake Michigan. Many of the angler returns for this study came from Michigan anglers. Likewise, Wisconsin anglers during this same time period caught numerous CWT chinook that upon CWT extraction and decoding, proved to be Michigan DNR study fish. It is apparent from this and other CWT studies, that the stocking location of chinook salmon has little to do with where in Lake Michigan these fish were caught during the open lake fishery. It is equally apparent that chinook do imprint, and have a high degree of stream fidelity at maturity.

In future chinook studies on Lake Michigan, angler recoveries should be encouraged. Angler recoveries of CWTs contributed an important and unexpected vantage point of analysis to this study. In past studies an extensive amount of effort was put into collecting CWTs from anglers with limited success. In this study, even though the effort to recover CWTs from anglers was not as extensive, the limited recoveries were important in the interpretation of the study results.

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NEARSHORE RAINBOW TROUT STOCKING EXPERIMENT

There is a strong public demand for nearshore fishing opportunities on Lake Michigan. Nearshore fishing opportunities for Lake Michigan trout and salmon have declined since the late 1980's due to changes in species or strains stocked, reduction in the Lake Michigan forage base or perhaps from clearer water nearshore making trout and salmon more difficult to catch. With reduced yellow perch abundance and salmon and trout moving farther offshore, anglers have requested the Wisconsin DNR to evaluate the stocking of rainbow trout to increase nearshore fishing opportunities.

The original study outline called for the stocking of six ports with two strains of rainbow to facilitate the evaluation of the effectiveness of rainbow stocking and to identify what strain to stock in the future through direct comparison of the performance of each strain. After taking input from anglers, the Arlee strain of rainbow trout was selected to be stocked. Following the initial stocking of Arlee, a second strain, Kamloops rainbow trout was identified to be part of this study. The ports of Kenosha, Milwaukee, Sheboygan, Manitowoc, Algoma and Sister Bay were the locations selected for the experimental stocking of rainbow trout for this study. The stocking goal was to stock 10,000 rainbow of each strain at each port for three years.

Stocking History

<u>Arlee Rainbow Trout</u>

The ports of Kenosha, Milwaukee, Sheboygan, Manitowoc, Algoma and Sister Bay each received a stocking of 12,000 Arlee in the spring of 2001. When stocked, the Adipose-Left Pectoral (ALP) clipped fish averaged 174 mm in length and 55.1 g in weight.

In 2002 because of hatchery shortfalls, Manitowoc and Milwaukee each received a stocking of 7,500 Arlee while the other four ports were not stocked. The Left Pectoral (LP) clipped fish averaged 170 mm in length and 54.5 g in weight when stocked.

In 2003, each of the six ports received 10,150 Arlee rainbow. The ALP clipped fish averaged 182 mm in length and 74 g in weight at the time of stocking.

<u>Kamloops Rainbow Trout</u>

The first stocking of Kamloops occurred in 2003, when each of the six study ports received 10,300 Kamloops. The Adipose-Right Pectoral (ARP) clipped fish averaged 148 mm in length and 32 g in weight.

Harvest

<u>2001</u>

In 2001, anglers harvested an estimated 1,324 Arlee (Table 1). Harvested Arlee ranged in length from 229 to 432 mm and averaged 330 mm in length. Anglers fishing from piers or from the shore harvested most of the Arlee that were caught in 2001.

Table 1. The estimated 2001, 2002 and 2003 sport harvest of Arlee and Kamloops Rainbow Trout from the Wisconsin waters of Lake Michigan by fishery type.

	Arlee Rainbow						**Kamloops Rainbow**	
Fishery Type	**Total 2001 Harvest**	**% of Total 2001 Arlee Harvest**	**Total 2002 Harvest**	**% of Total 2002 Arlee Harvest**	**Total 2003 Harvest**	**% of Total 2003 Arlee Harvest**	**Total 2003 Harvest**	**% of Total 2003 Kamloops Harvest**
Boat	62	5%	1,259	78%	46	5%	0	0%
Pier/Shore	1,262	95%	285	18%	813	95%	267	100%
Stream	0	0.0%	61	4%	0	0%	0	0%
Total	1,324		1,605		859		267	

<u>2002</u>

In 2002, it was estimated that anglers harvested 1,605 Arlee (Table 1). Most of the harvested fish (1,116 of 1,605) were from the 2002 stocking. These LP clipped fish averaged 566 mm in length and 1.7 kg in weight. The 2001 stocked Arlee were also harvested, but in much lower number. The ALP clipped fish averaged 547 mm in length and weighed 2.3 kg. Unlike 2001, the boat fishery took the majority of the harvested Arlee in 2002. Shore and pier anglers also harvested a substantial number of Arlee in 2002, but harvested fewer than in 2001. However, the harvest estimate and average length and weight must be viewed cautiously because of the small number of fish handled that had the appropriate clips.

<u>2003</u>

It was estimated that anglers in 2003 harvested 1,126 Arlee and Kamloops rainbow trout (Table 1). Of this total, 859 (76%) were Arlee strain rainbow, with the remaining 267 (24%) Kamloops strain rainbow trout.

Anglers caught all three years of stocked Arlee during 2003 fishing season. Arlee that were stocked in 2003 represented 58% of the catch, with the remainder of the catch evenly split between fish stocked in 2001 and 2002. Most (95%) of the Arlee harvest was from anglers fishing from piers or from shore, with only 5% of the harvest by boat anglers (Table 1). By 2003, fish stocked in 2001 had grown to average 658 mm in length and 3.1 kg in weight, with 2002 stocked fish averaging 610 mm in length and 2.4 kg in weight. 2003 stocked Arlee averaged 414 mm in length and 1.1 kg in weight when harvested.

It was estimated that anglers harvested 267 Kamloops rainbow trout during the 2003 fishing season (Table 1). All reported Kamloops harvest was from anglers fishing from piers or from the shore. Harvested Kamloops averaged 358 mm in length and 0.7 kg in weight.

Summary

The first three years of creel survey data is encouraging and indicates that the Arlee and Kamloops rainbow trout may be benefiting nearshore anglers. Since the inception of this project, 65% of the nearshore rainbow harvested have been by anglers fishing from piers or from the shore. It also appears that the fishing are growing well as anglers have caught fish over 3 kg. Based on average length and weight after one summer in Lake Michigan, Arlee strain fish are larger in size and caught in greater number than Kamloops strain fish. However, stocking must continue through 2005 before a final evaluation is made on the success of the program and a determination made what strain, if any, is stocked as normal production fish.

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FISH HEALTH

Bacterial Kidney Disease in Hatcheries

From July through October 2003, mortality of Coho salmon at our Lake Mills and Westfield hatcheries increased due to Bacterial Kidney Disease (BKD). This is the first time active BKD has occurred in the hatcheries since 1998. The triggers for these outbreaks were overcrowding and bird harassment at Lake Mills, and reduced water flow due to operation of a new municipal well at the Westfield hatchery (little or no flow for a 24 hour period and 50% reduced flows thereafter). Our INAD to use erythromycin to treat BKD expired in 2002 and was not renewed because of excessive workload (no time to write the annual reports required by FDA). We asked FDA-CVM for permission to treat these Coho with erythromycin one time in 2003 to control this active outbreak. We received permission to treat the fish, and they were fed medicated feed in October. Prior to treatment, monthly mortality at Lake Mills averaged 1500 fish (July –September; about 344,000 Coho on site). In October, mortality was about 400 fish, and averaged 28 fish in November and December. The reduction in mortality post-treatment was remarkable. Efforts are underway to renew the INAD, which would allow salmonids in WI, MN, IL, MI, PA and at USFWS hatcheries to be treated with erythromycin should the need arise.

Broodstock

We saw more Chinook adults with clinical signs of BKD at the Strawberry Creek weir in Fall 2003 than we have since the Lake Michigan epizootics in the late 1980's. We also saw higher prevalences of *R.s.* based on kidney smears from Coho at the Root River Spawning Facility (we did not sample any Coho at the Besadny Facility because so few Coho returned to spawn). Intensity of *Echinorhynchus salmonis* (spiny headed worm) infections in Chinook and Coho increased by 100% on average in 2003, compared to previous years, suggesting a shift in diet may have occurred. It will be interesting to see what happens when Lake Michigan warms up in Spring 2004.

Skamania steelhead broodstock that returned to streams in Fall 2003 were injected with oxytetracycline to treat furunculosis infections they carried from Lake Michigan. More *Aeromonas salmonicida* (causative agent of furunculosis) has been isolated from all Lake Michigan broodstocks in the most recent three years than in the past ten years. There is no speculation why this has happened. The Skamania broodstock also received monthly thiamine treatments (350 ppm bath for 30 minutes) from the time they were transferred to the time spawning began. This treatment helps prevent thiamine deficiency in the broodfish and also seems to keep the skin from developing fungal infections.

Spotted Musky

Because *Piscirickettsia sp.* was detected by Dr. Mohamed Faisal in spotted musky from Lake St. Clair in 2002, WI DNR did not import any spotted musky eggs in 2003. However, about 200 of the 2002 yearclass of spotted muskies were held overwinter and rearing continued through summer of 2003. Before the fish were stocked, samples from ten fish were sent to Dr. Faisal to be tested for *Piscirickettsia*. The fish were negative for *Piscirickettsia*, however, Dr. Faisal did isolate a reovirus from the fish. More tests are being done to characterize the virus. In general, reoviruses do not often cause disease in fish.

Vaccination

We continue to vaccinate brown and brook trout for furunculosis. Some of these brown trout are stocked in Lake Michigan. In 2003, we noticed a big improvement in efficacy of the vaccination at our Brule hatchery. We think the reasons the vaccination was more effective were 1) in the past, fish were vaccinated when they were about 150/lb; in 2003, we reduced production due to budget problems and had the space to rear fish to a larger size (about 100-120/lb) before vaccinating them. The immune system of trout is not fully functional until the fish are larger than 400/lb (or 1 gram). In general, the larger the fish at vaccination, the more effective the vaccine will be; 2) fin condition at the time fish were transferred to the Brule hatchery was excellent. In the past, fins have had various levels of erosion. These open wounds may allow *A. salmoninarum* (which is in the Brule hatchery water supply) direct entry to the fish, overwhelming the fish with too many bacteria before the immune system re-boosts itself. When the exposure of the fish to the bacteria is via intact skin, it simulates the vaccination process (which is a dip treatment) and the immune system can get geared up before too many bacteria become systemic.

In 2004, we plan to feed the EWOS "boost" diet (which contains immune enhancing compounds such as nucleotides) for one week, vaccinate the fish and continue feeding boost for the following three weeks to see if enhanced protection against *A. salmoniarum* occurs. Antibody production post-vaccination is a function of water temperature and stress. The colder the water temp, the longer it takes to produce antibodies. For trout at 48 F, it takes 3 weeks for optimal antibody production to occur. If fish are stressed during this window, the cortisol released during the stress event will suppress the immune function of the fish, and antibody production will be poor. Fish are not handled for at least three weeks post-vaccination.

We have not collected fish health samples from Lake Michigan salmonids during the summer months since 1994. Considering the current ecosystem concerns (foodweb, increasing bacterial infections in broodstocks, etc.), it would be worthwhile to make an effort to collect samples this summer (both from tournaments and from assessment work). This is only feasible if the fish health program obtains more staff.

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